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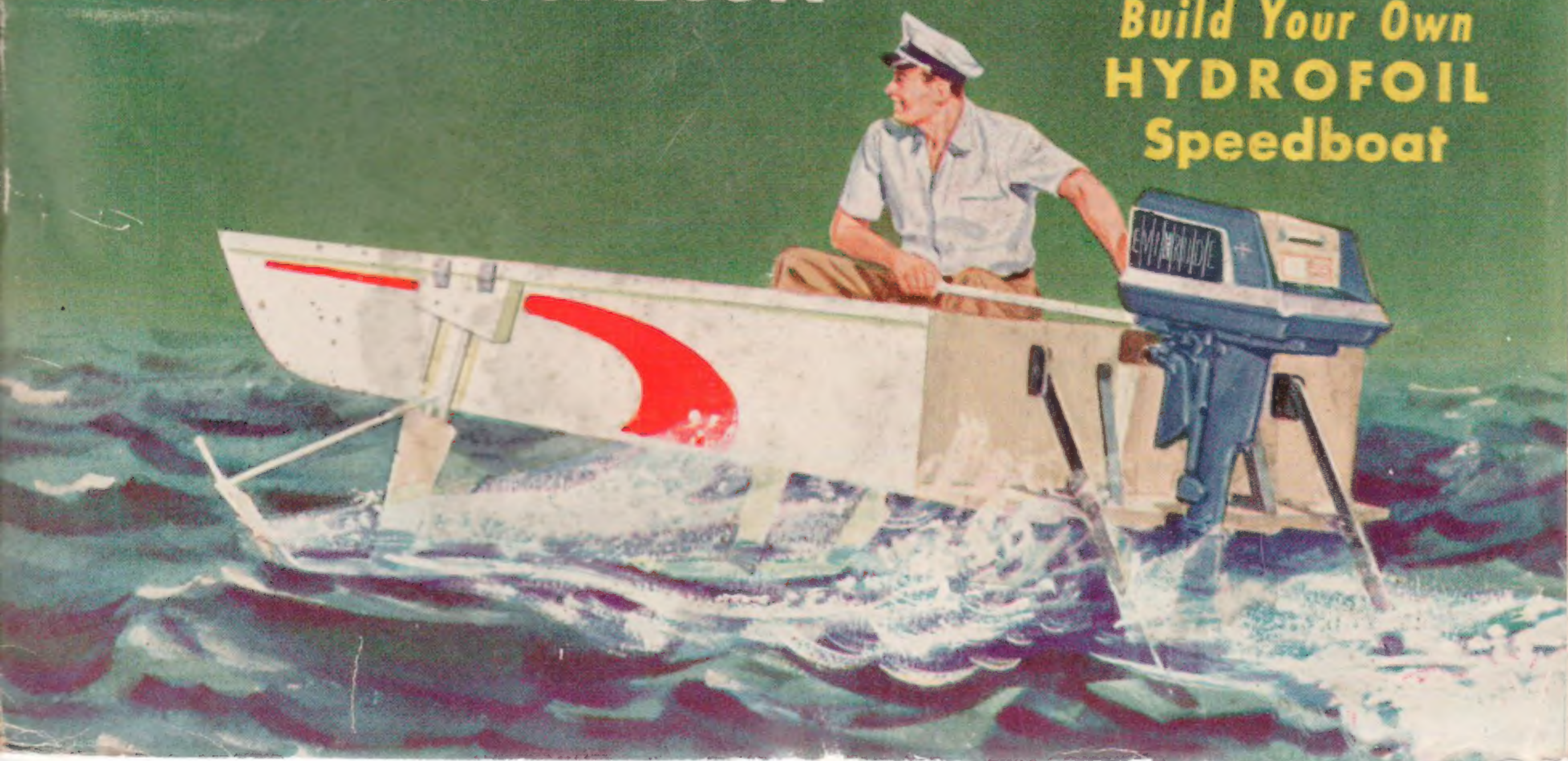
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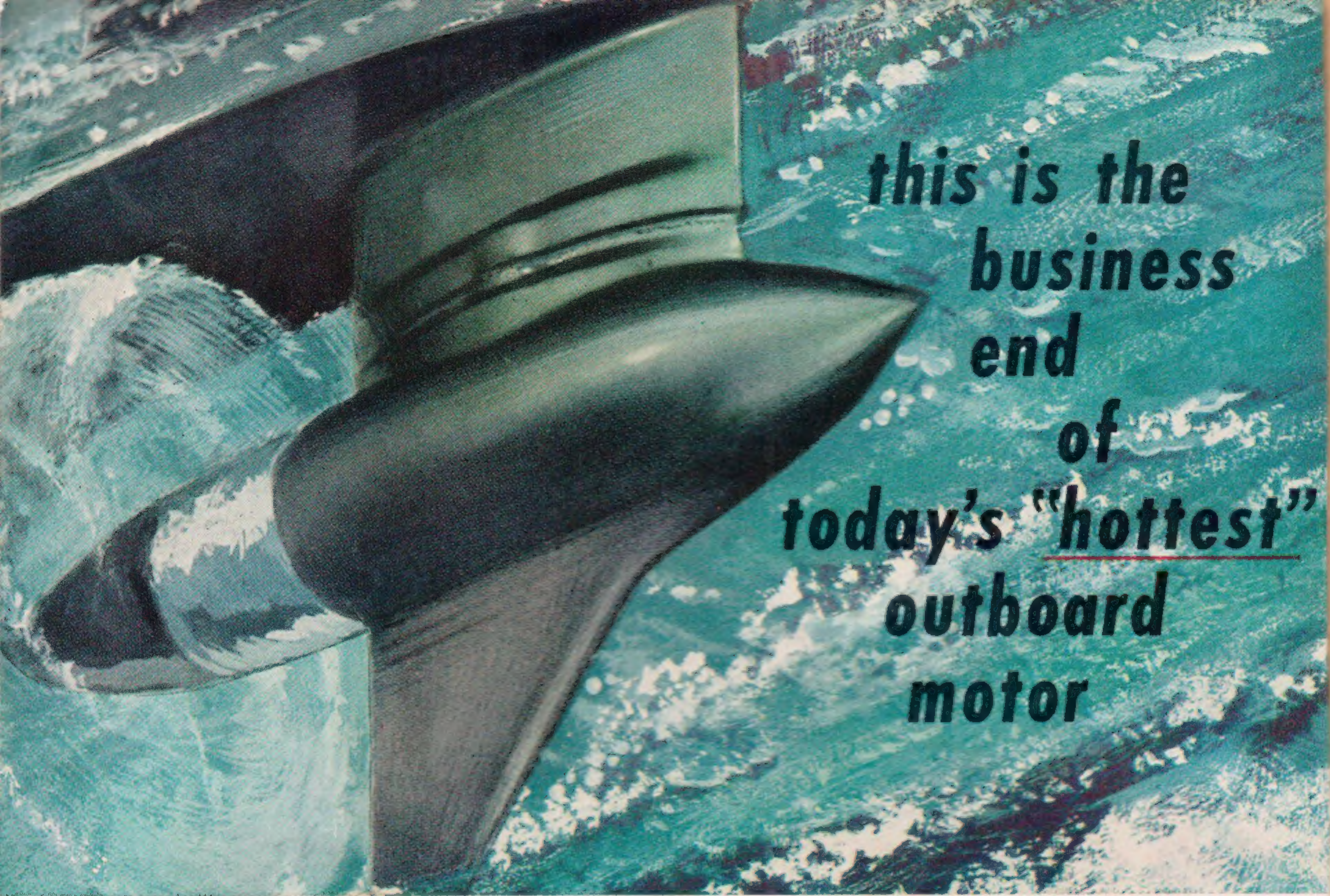
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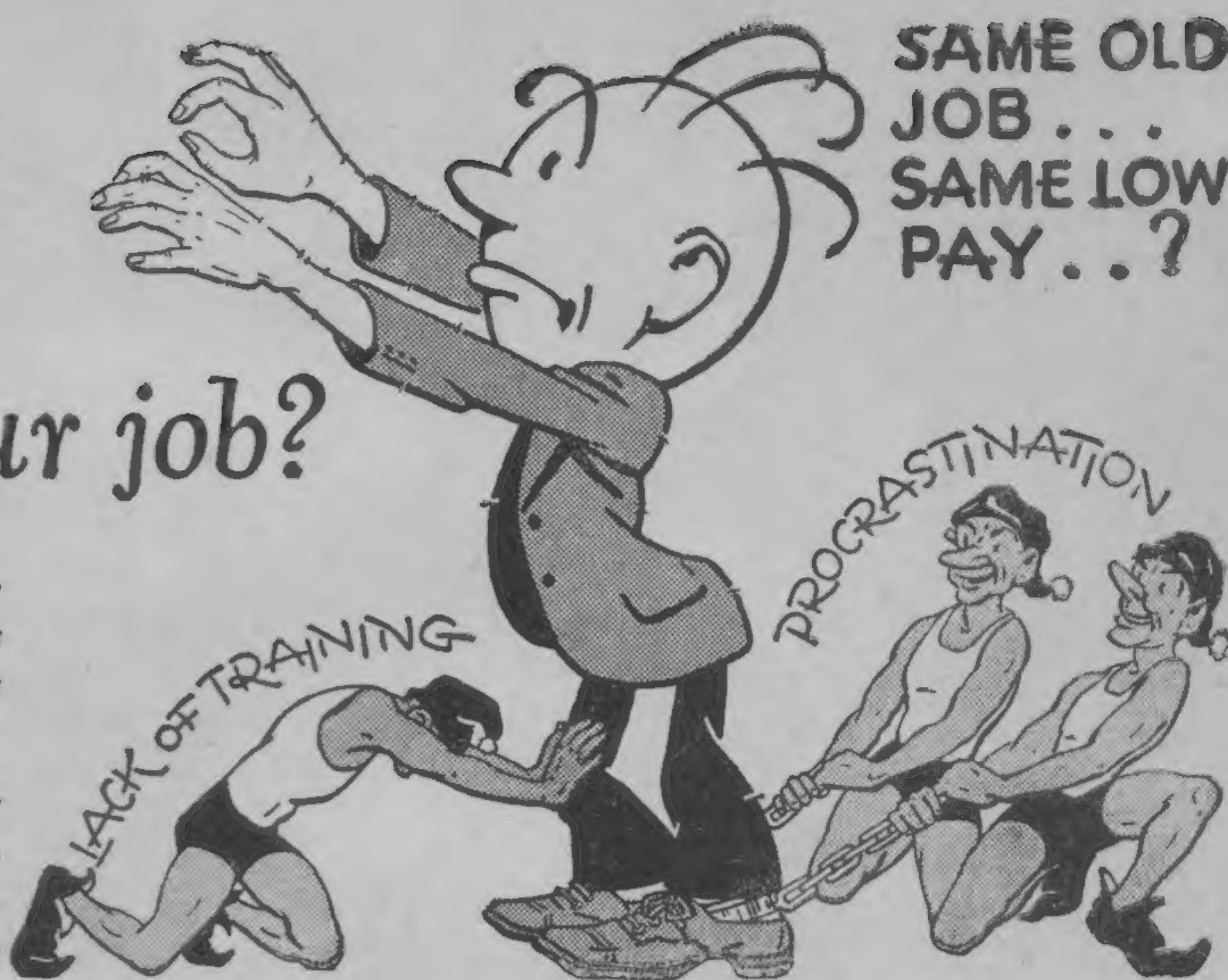
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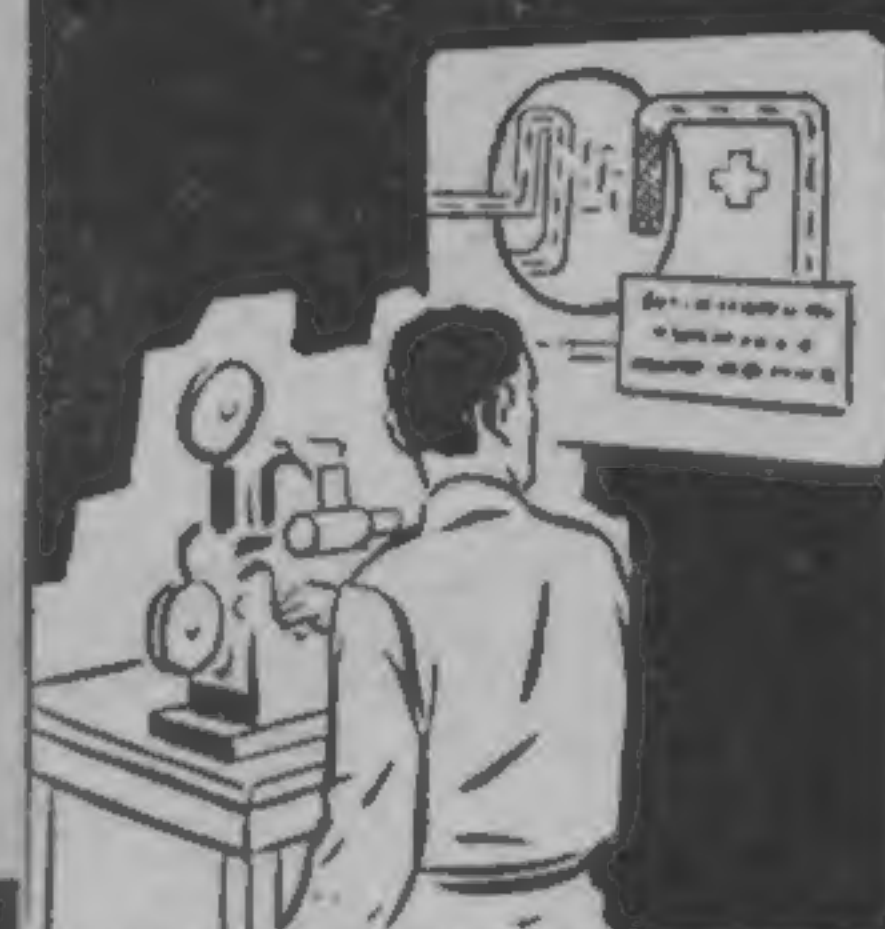
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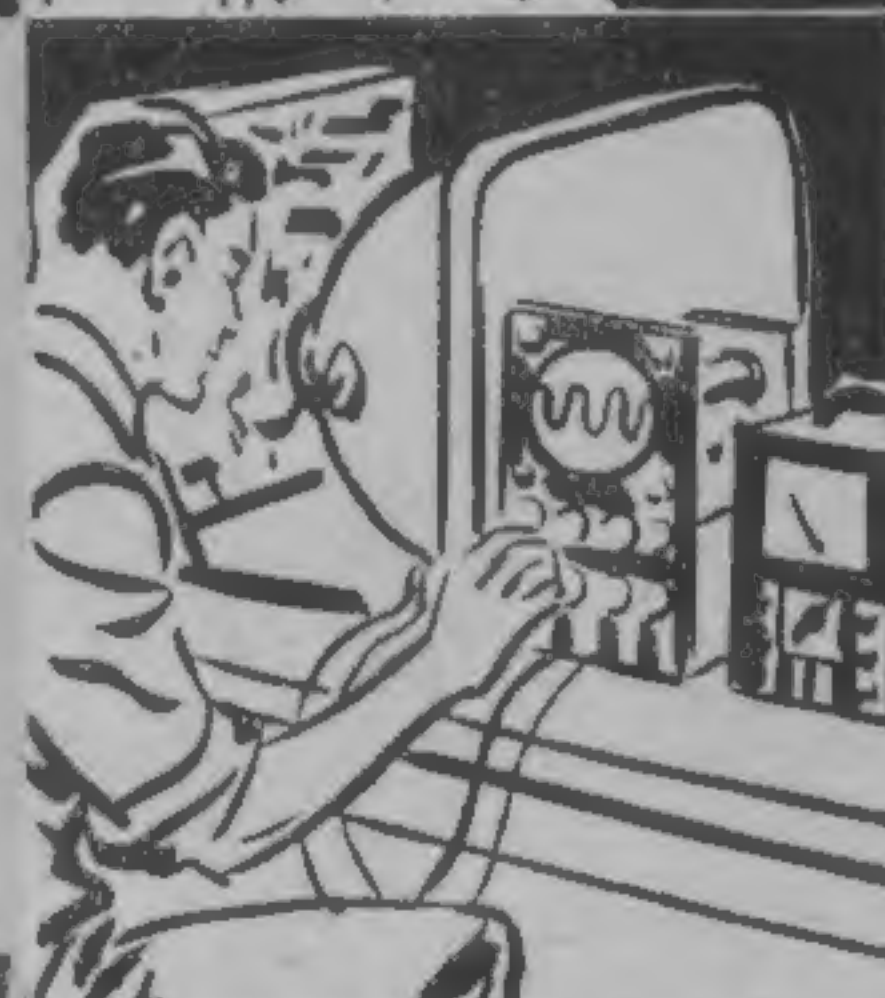
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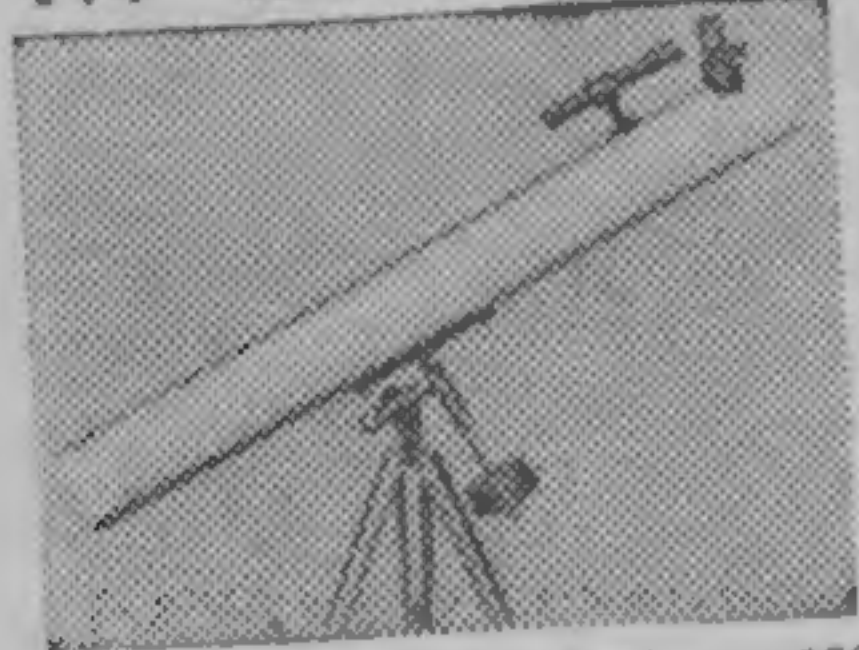
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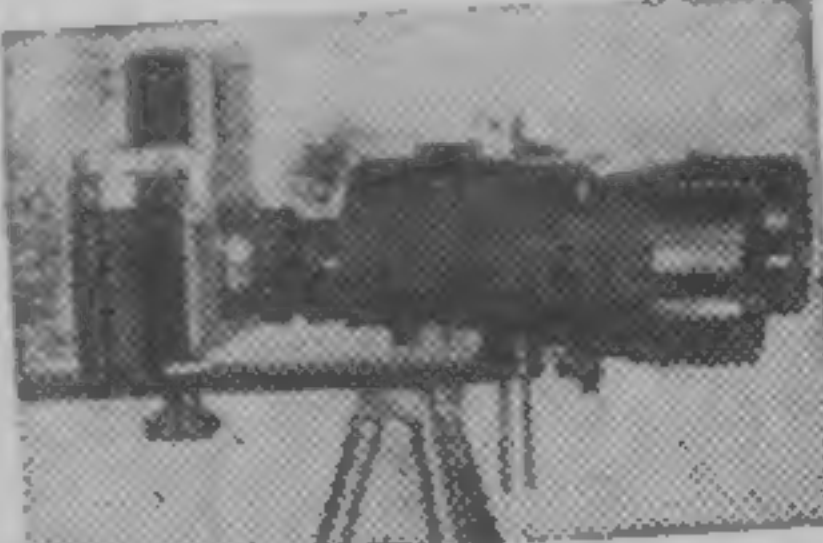
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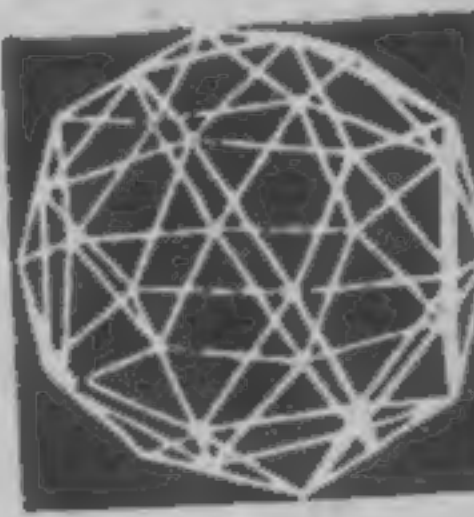
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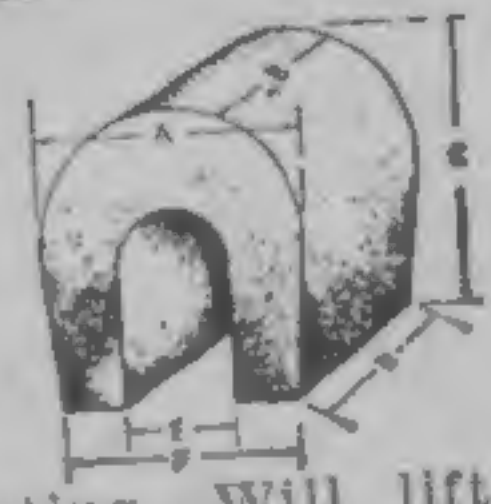
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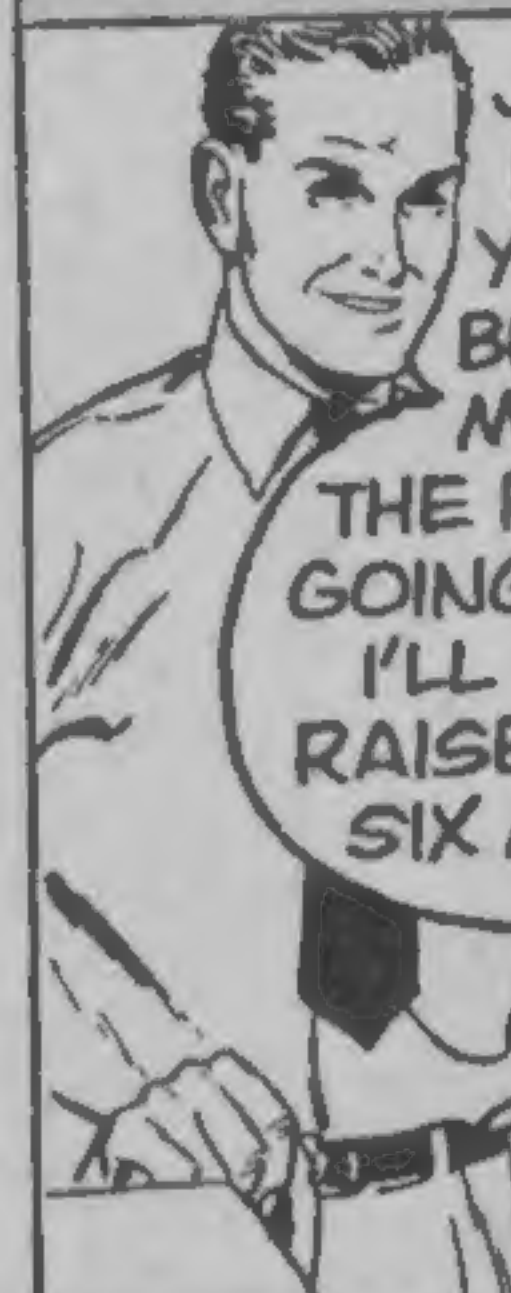
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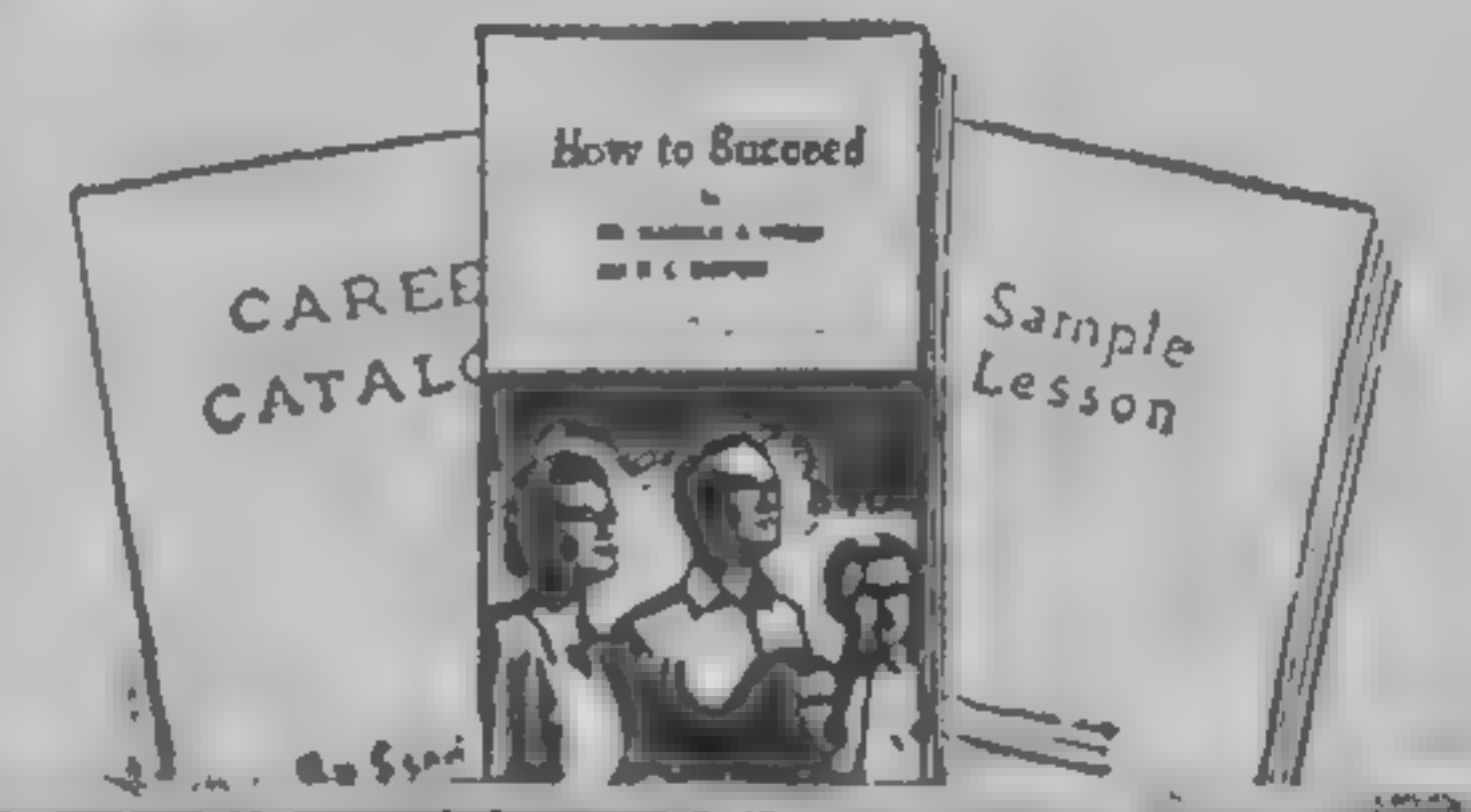
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CTS SHOWS YOU

how to locate any trouble with refrigerators, vacuum cleaners, irons, toasters, motors, in fact, anything electrical . . . then how to quickly fix it . . . and what to charge. CTS also shows you how to solicit business, where to get repair parts wholesale (over 270 supply sources listed). ALSO, how to build power tools you want from spare parts and CTS teaches you Welding, House Wiring, Nickel Plating, Saw, Scissor and Lawn Mower Sharpening, Bicycle Repairing and other profitable sideline or full time businesses.

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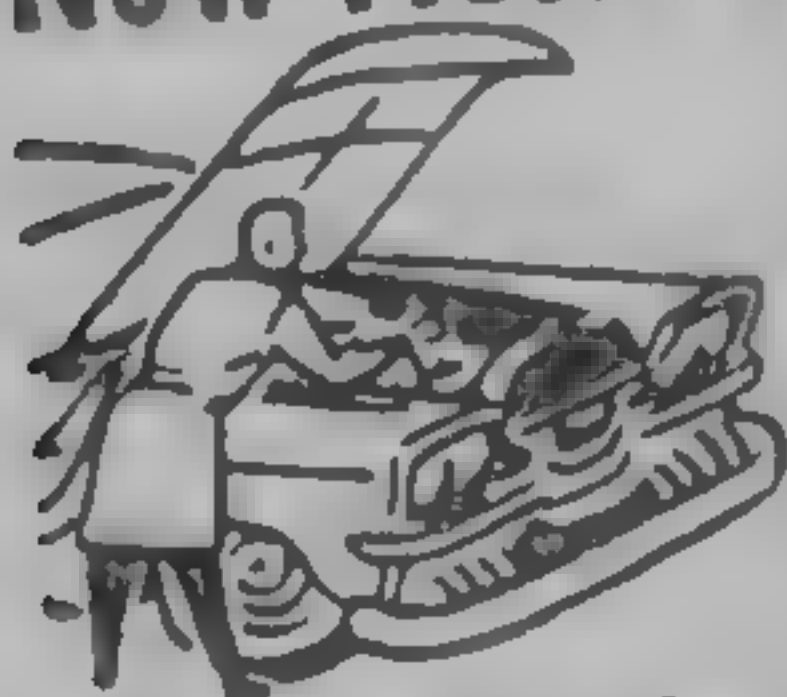
ONLY CTI SENDS PARTS
AND TOOLS TO BUILD A
CONDENSING UNIT!



TRAIN QUICKLY AT HOME WITH KITS

A BETTER JOB, MORE MONEY, BRIGHT FUTURE—All three can be yours in the Refrigeration and Air Conditioning field! This industry is growing, growing, GROWING so fast that 20,000 must be trained each year to keep up with service demands! Over 150,000,000 units are now in use—and the industry produces an additional 6,000,000 refrigerators, air conditioners and freezers annually. Not only homes, but stores, offices, restaurants, factories, motels and transport systems use some form of refrigeration. Opportunities for a good job—even a business of your own—are well within your reach... just a few months of training away! Isn't it worth your while to get full information? *It will be sent if you fill out and mail coupon on next page.* No cost nor obligation!

New Field: Auto Air Conditioning



New applications of refrigeration are developed almost daily. One of the fast-growing fields is auto air conditioning. Experts say that this equipment will become as standard as automatic transmissions. Already dealers are advertising

for skilled refrigeration mechanics. There are opportunities in many places to open a shop of your own. Our brochure has information on this profitable, specialized field. It's well worth looking into.

Open A Shop—Enjoy Independence



Own a business. Be independent; keep all the profit; "give", not "take" orders. The refrigeration field is ideal for getting started on your own. You can make friends as you make calls. You can build up a list of customers and sign service contracts with stores, taverns, etc.

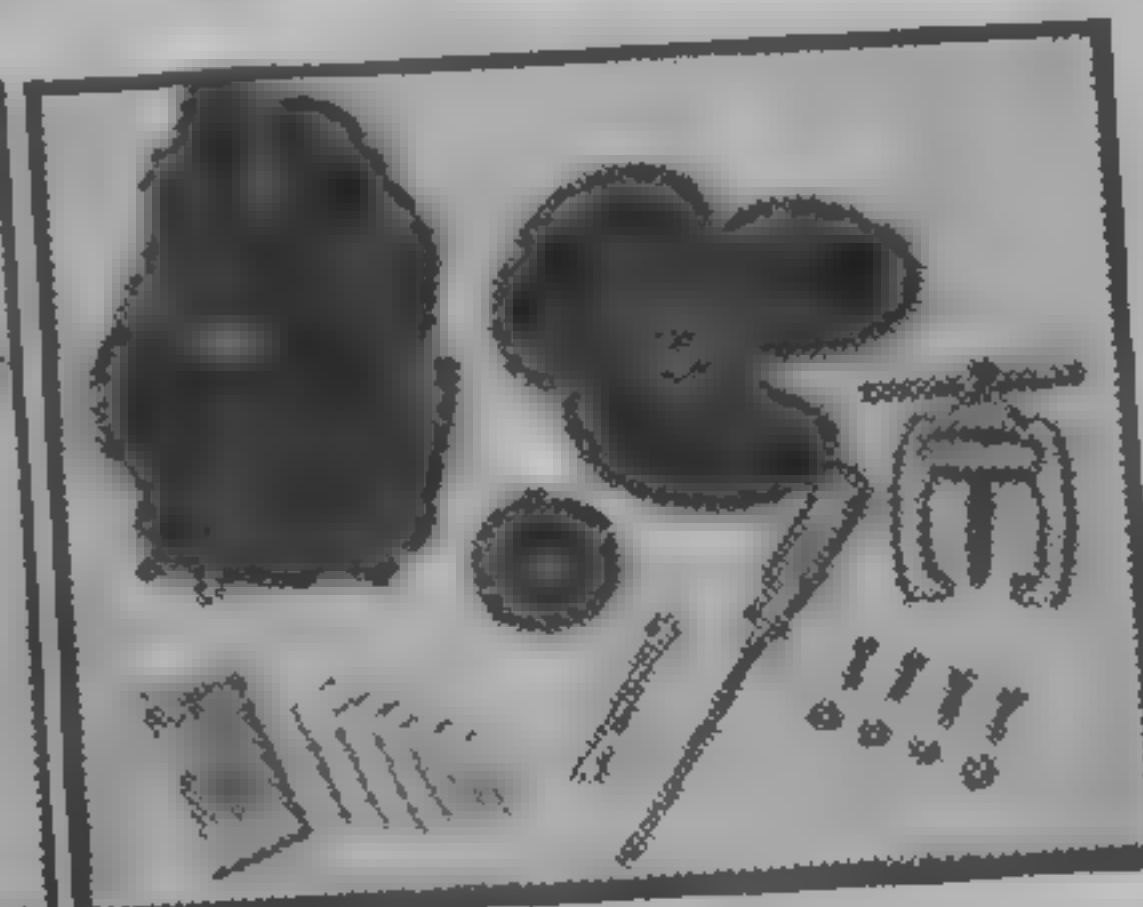
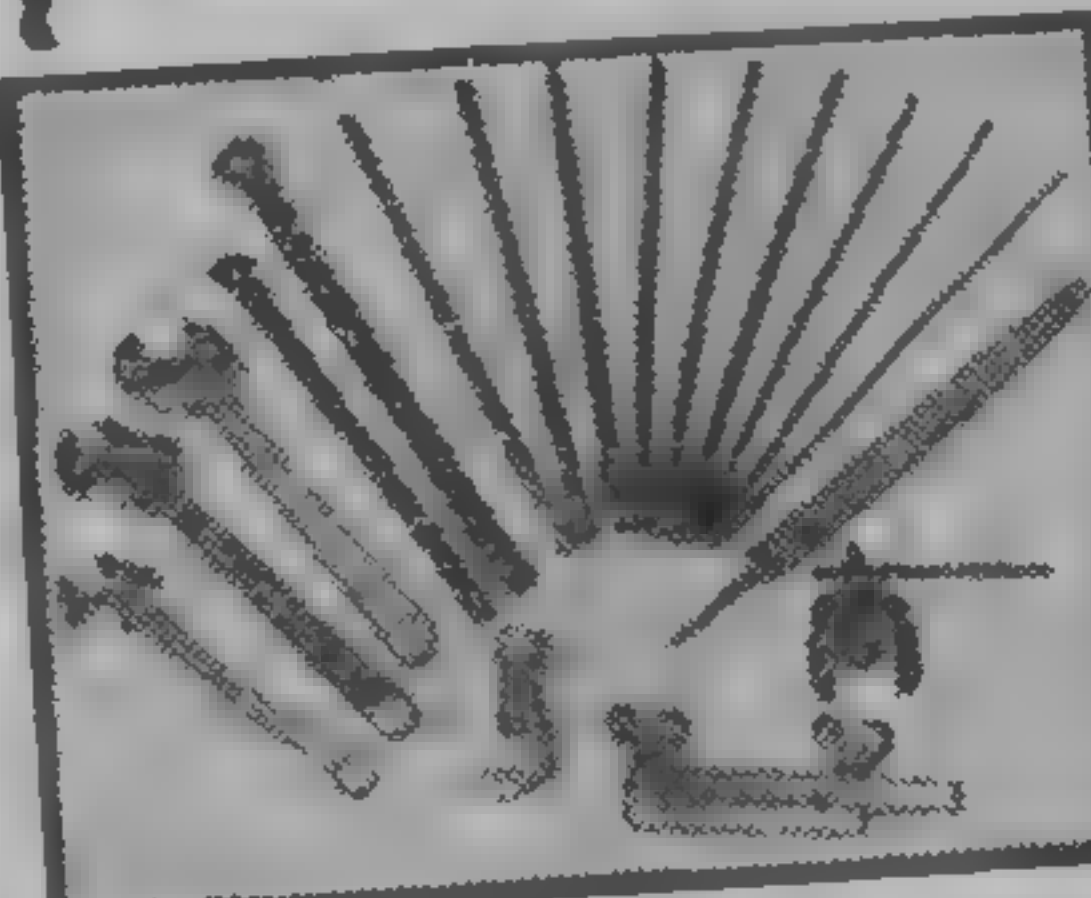
These CTI Men Are Making the Grade

"I have been very busy. Had an offer to work for an appliance dealer but it looks like I'll be in business for myself before long."—*Frank Fuller, Wells, N.Y.*... "Am now working in the field. Earn \$40 more per month than before."—*Frank Krotzer, Houston, Tex.*... "I not only got a job, but today am foreman, earning \$60 a week more than before I enrolled."—*E. E. Hughes, Chicago*... "Have my own business. Only problem is: Too much business!"—*Conrad King, Cynthia, Ky.* You can do as well!

MAIL COUPON ON NEXT PAGE TODAY

YOU LEARN FAST BECAUSE

YOU LEARN BY DOING. CTI makes home your training shop. During your training, you receive 25 big kits, including service tools. You assemble a heavy-duty, commercial-type, 1/4 h.p. condensing unit (illustrated at right). You build an air conditioner, refrigerator, freezer or milk cooler. You complete 23 training projects—do 10 service and trouble-shooting jobs such as you might encounter on actual calls. You get field-type training, *on-the-job* experience! Remember: CTI was the first school to offer practical training kits with lessons in the refrigeration and air conditioning field.



THESE ARE TWO OF THE 25 BIG KITS

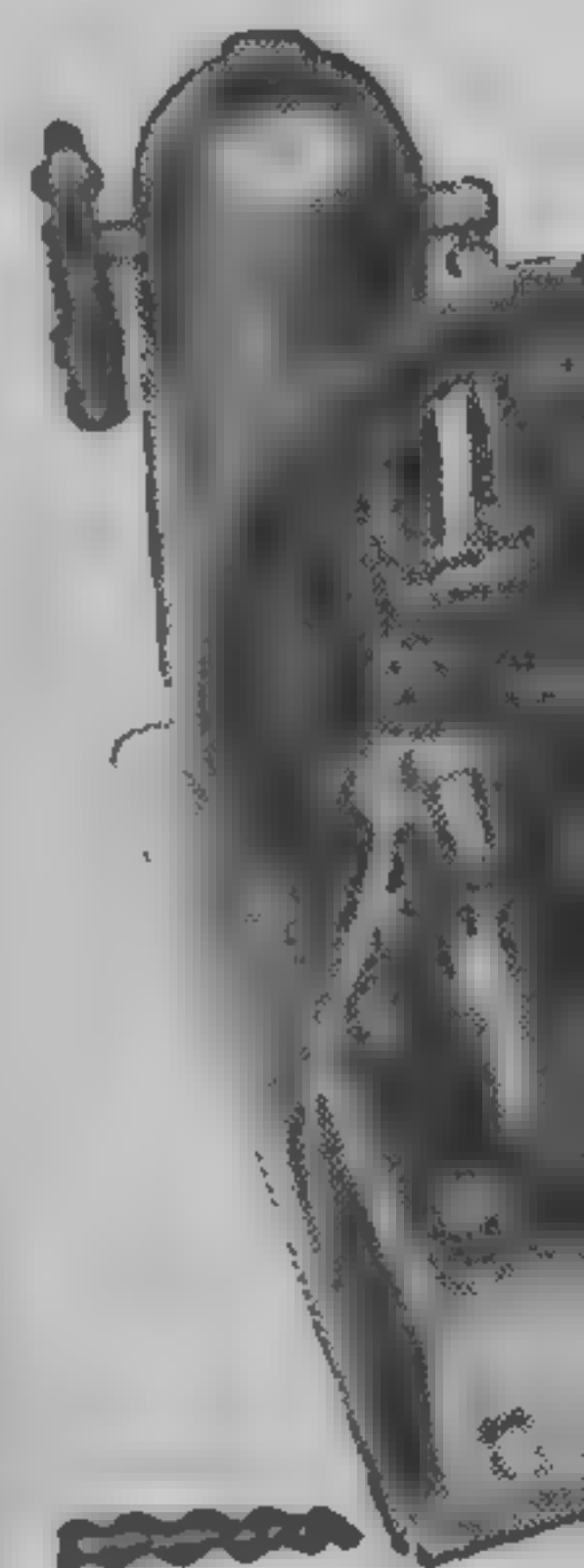
Kits are sent on a planned schedule to help you progress in easy stages. You develop skill, get experience, learn quicker this proven, Shop-Tested way. Above are but two of the 25 kits you will get during your training. One shows professional, high-quality mechanic's tools. You gradually build these kits into the refrigeration condensing unit (see next page.) The CTI training method is almost like a carefully-guided apprenticeship—except that it is faster, more professional. You train in spare time at home—no need to leave your family or give up present job!

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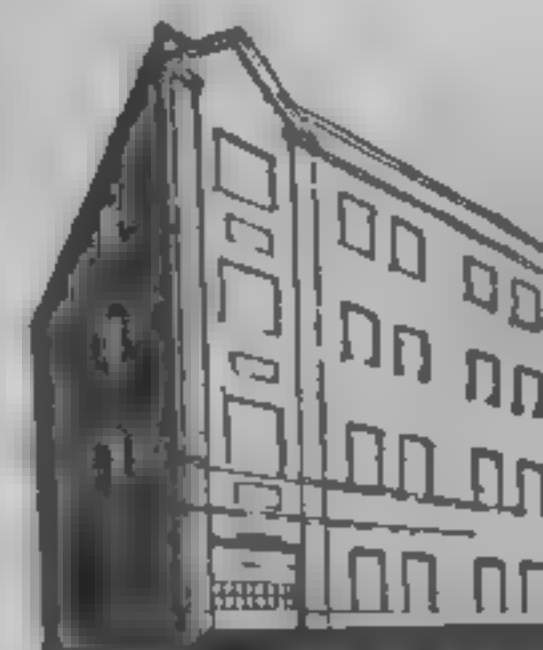
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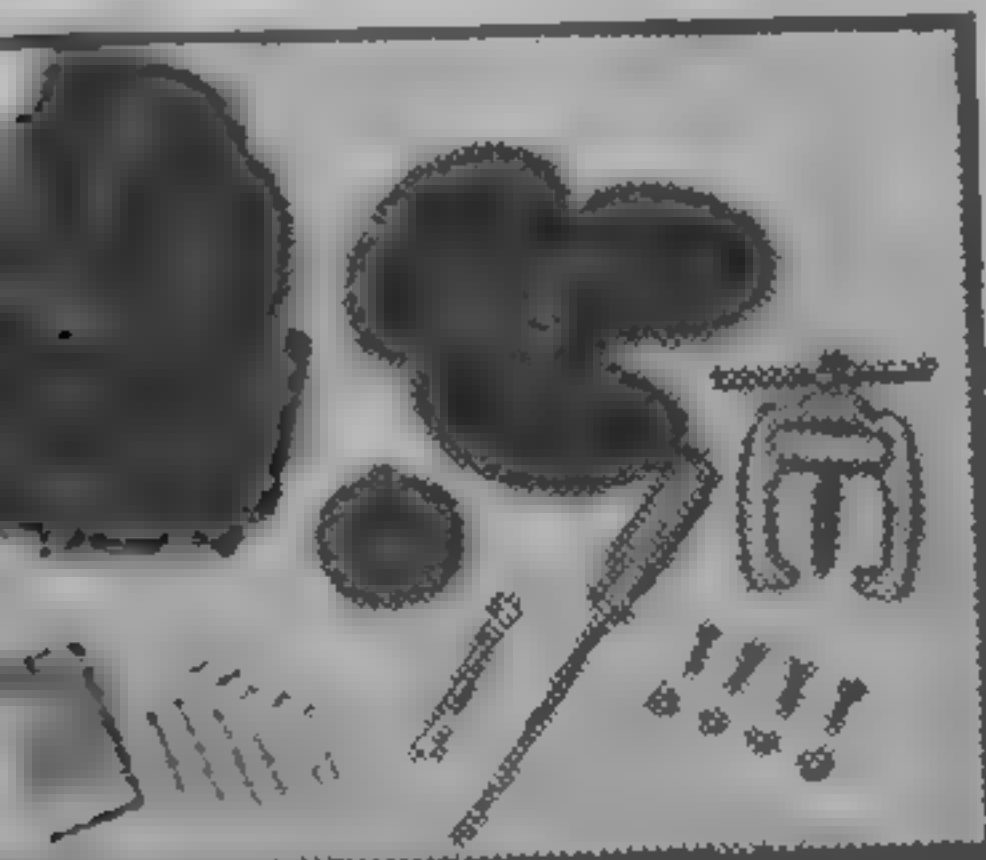
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a complete 23 training
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F THE 25 BIG KITS

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Speed is but one feature of CTI training, however. Of even greater value is the *practical* side of the course. The student not only learns at home in spare time—he gets experience as he trains because he practices with 25 big kits. Our new catalog explains job opportunities and training procedure. Mail coupon for your free copy.

A mechanic's job is clean, steady and well-paid. Over 20,000 new jobs open each year.

YOU PRACTICE



Easy to Earn Cash as You Train

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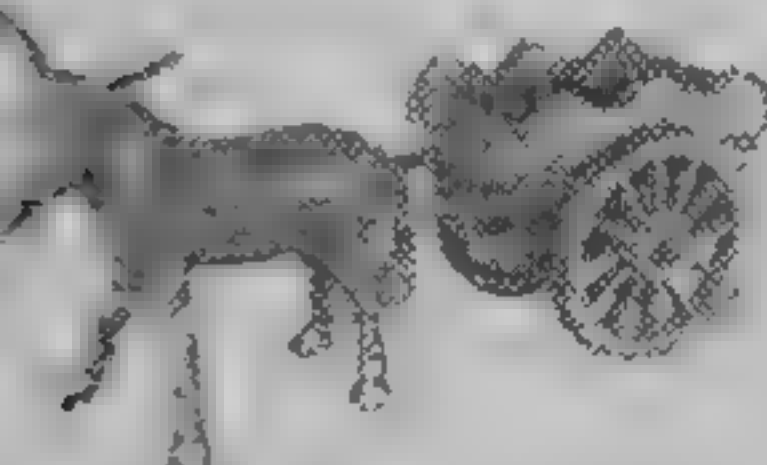


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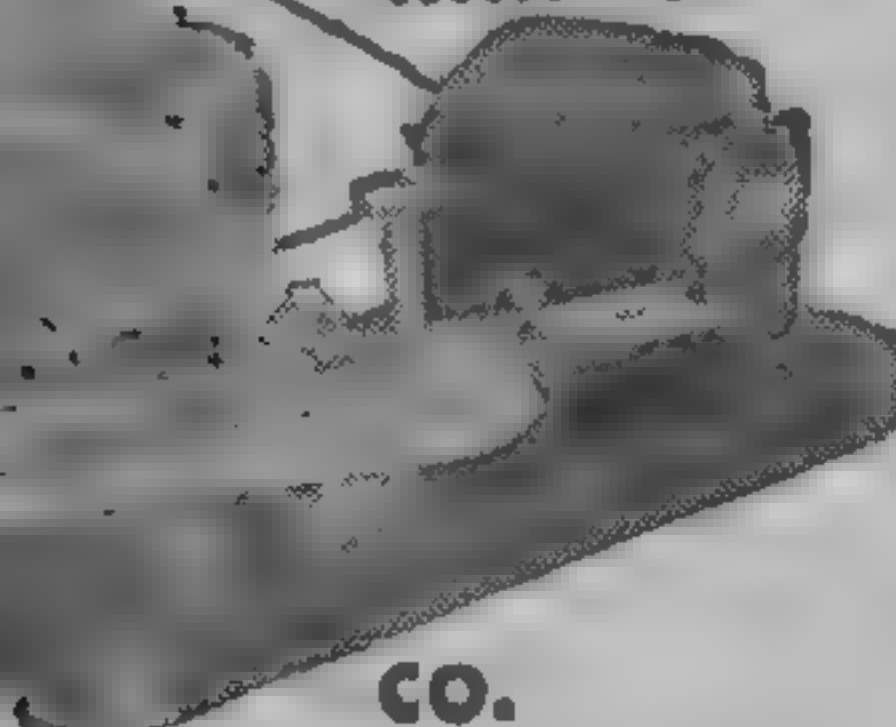
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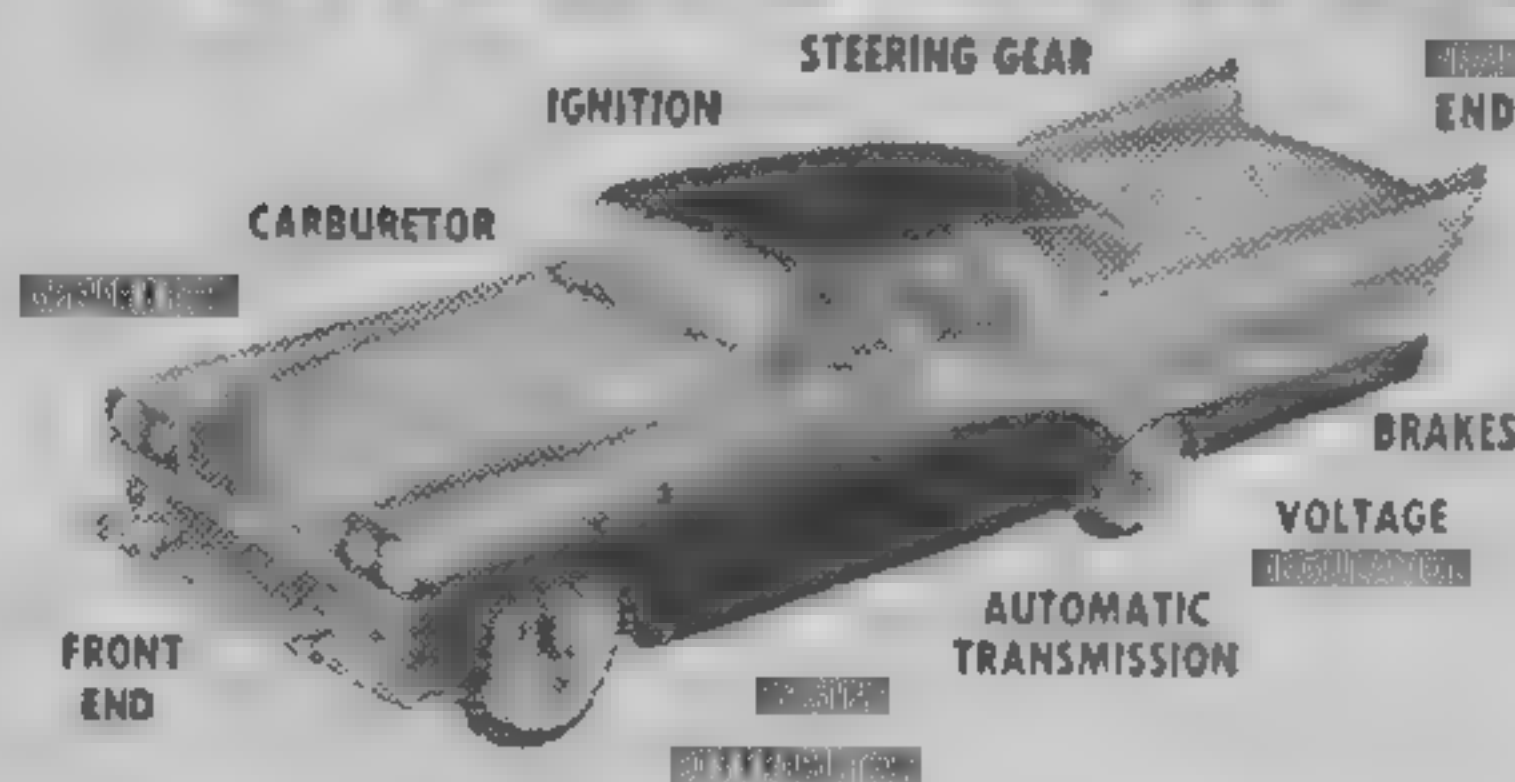
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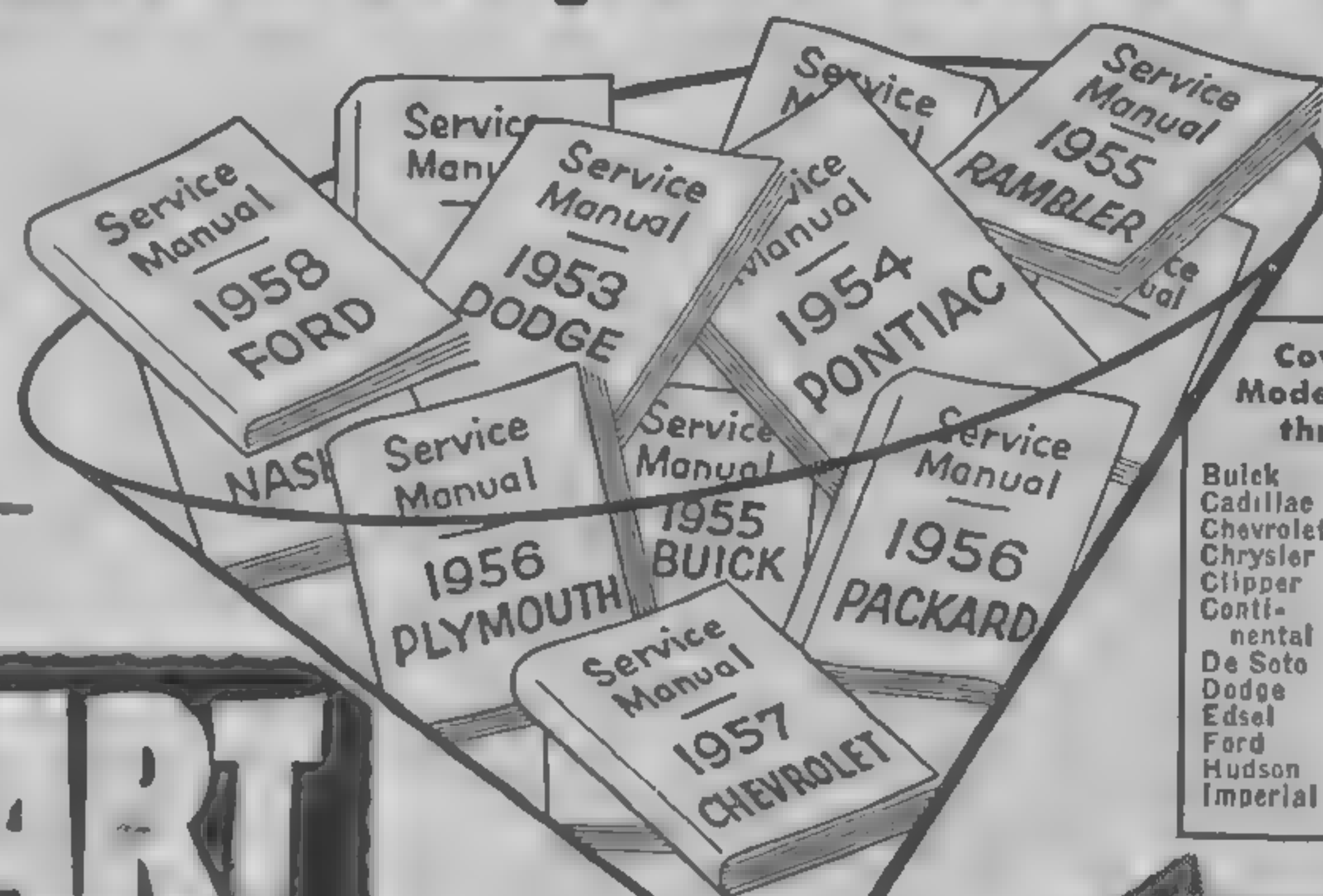
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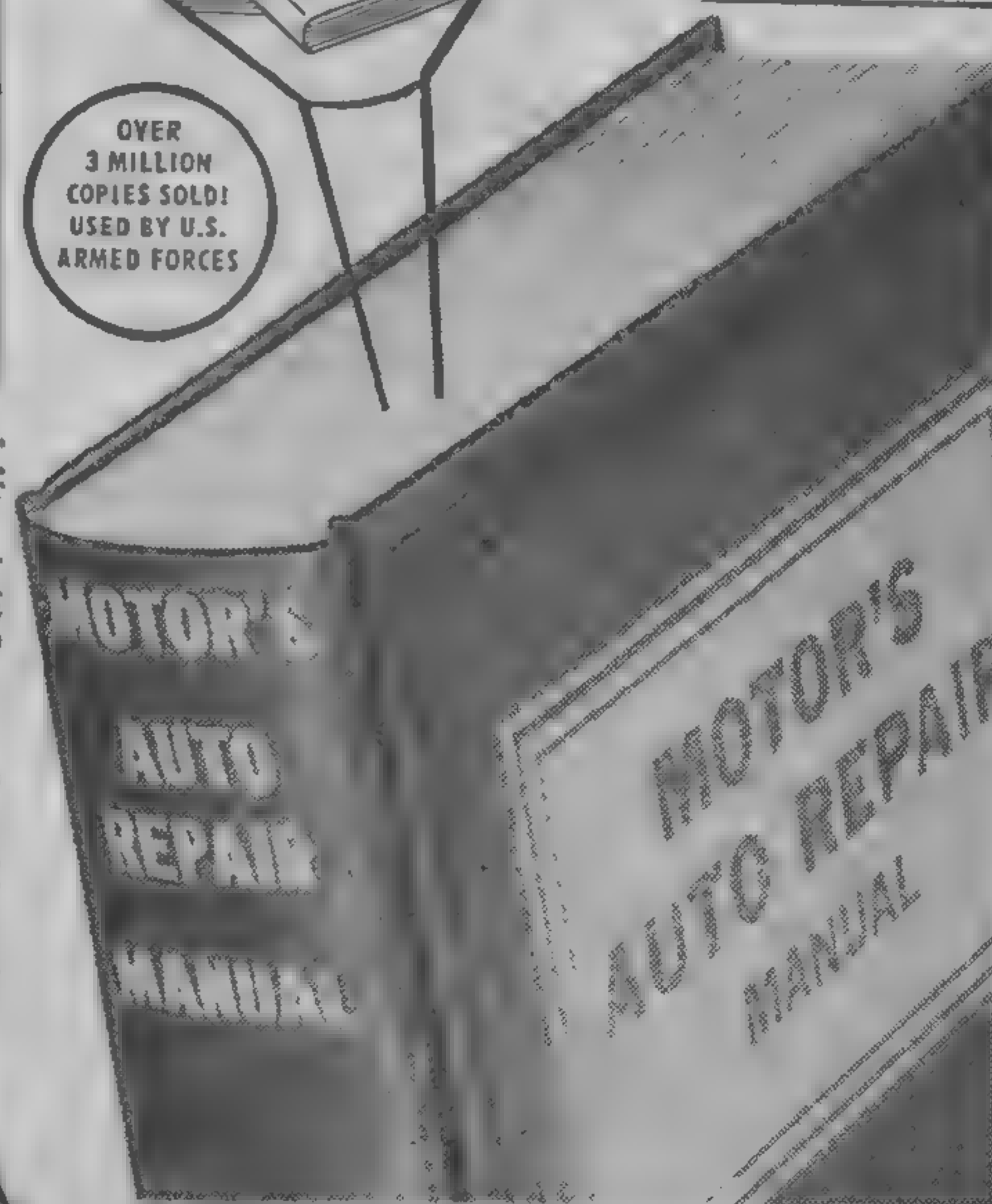
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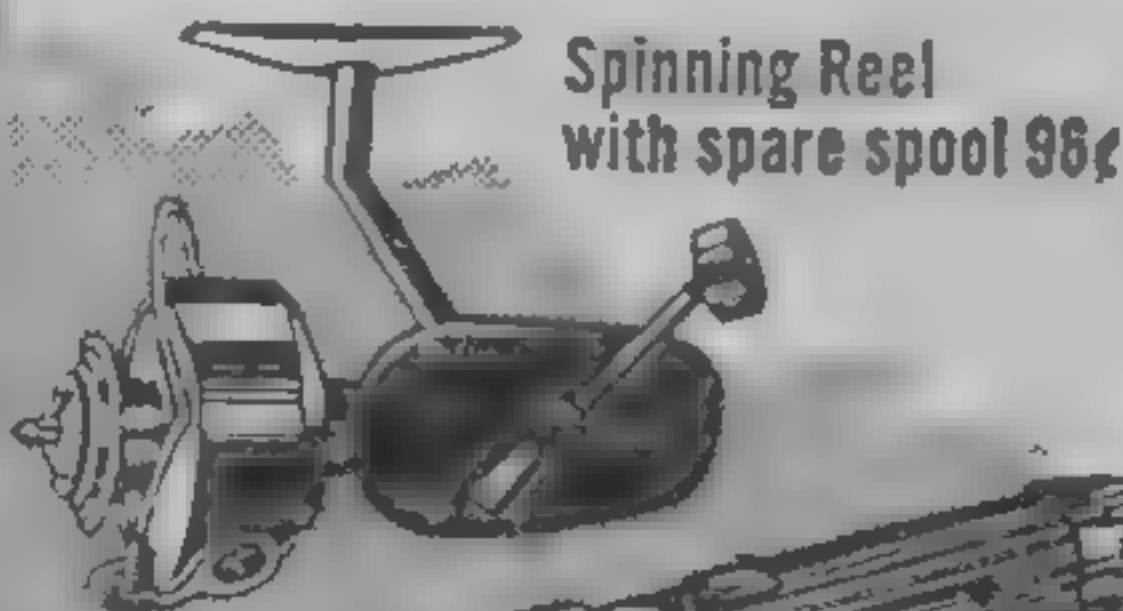
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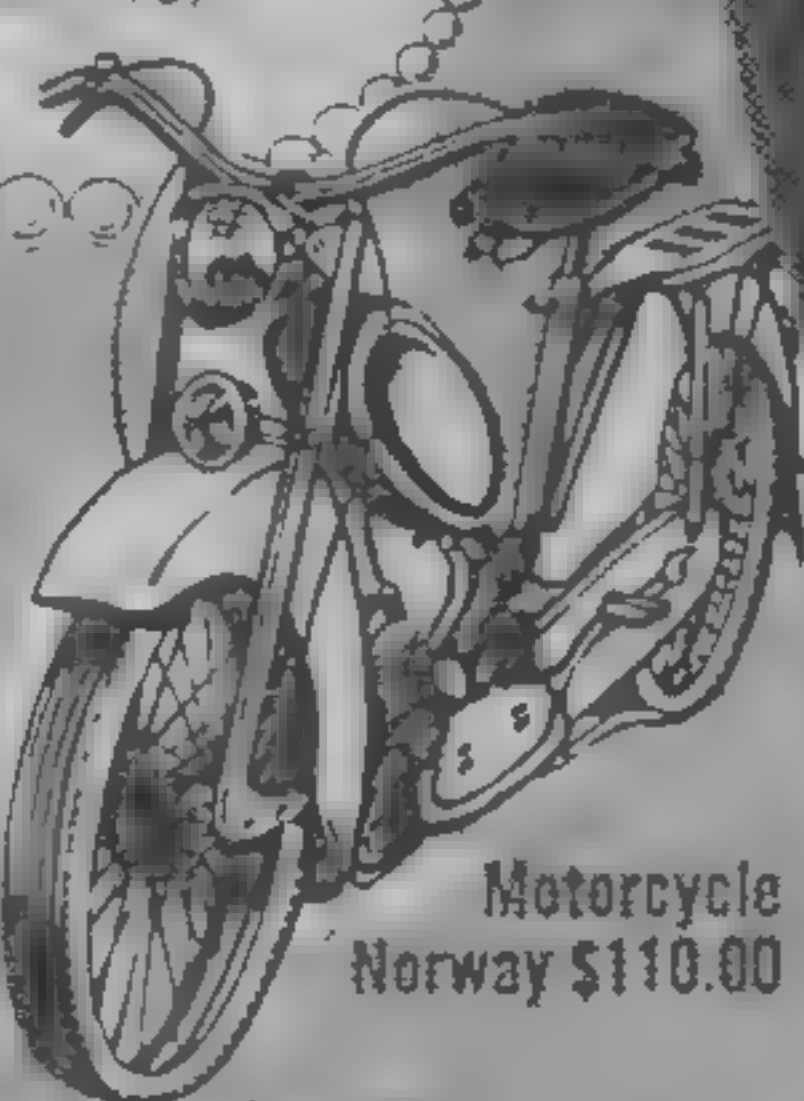
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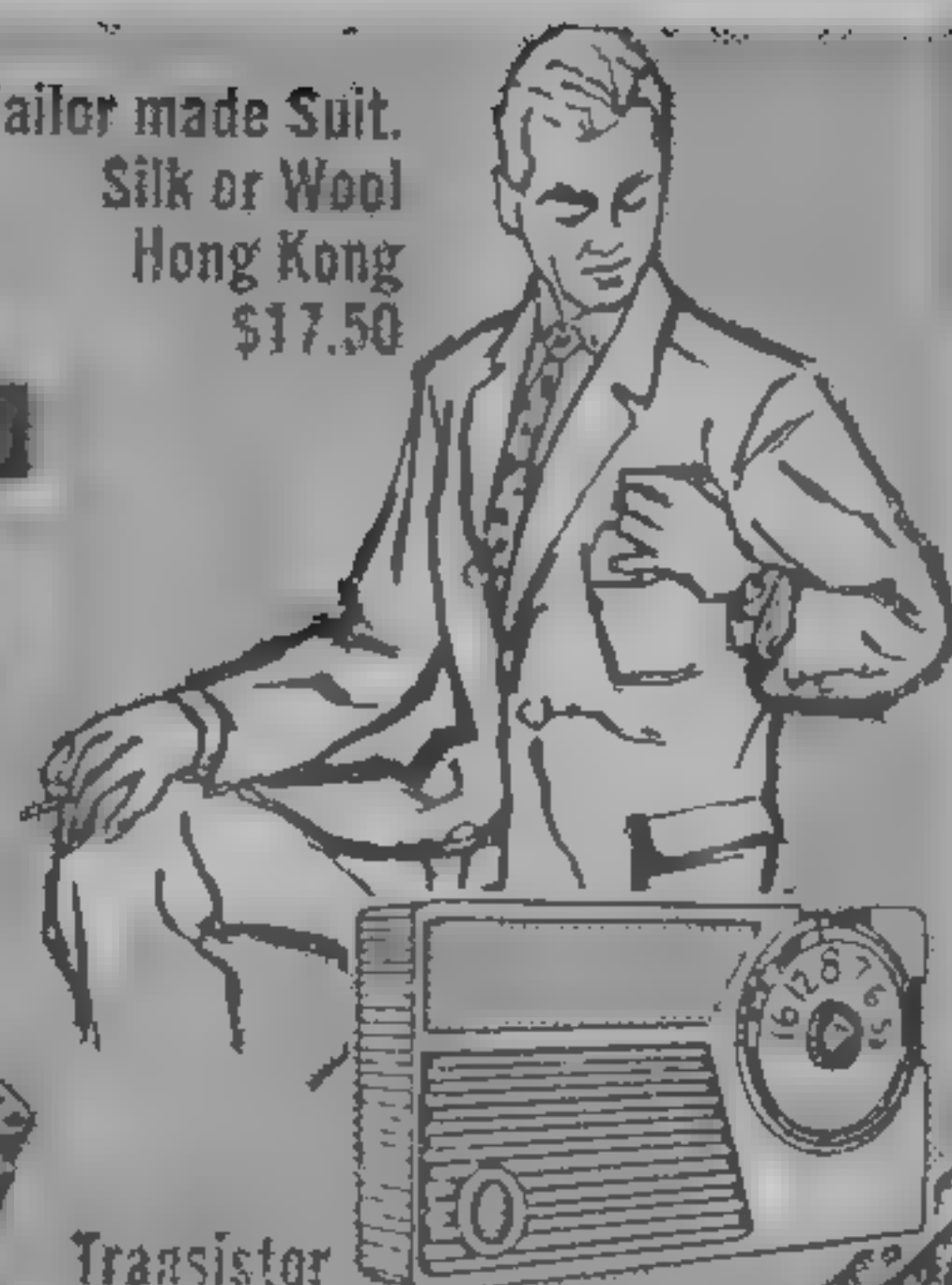


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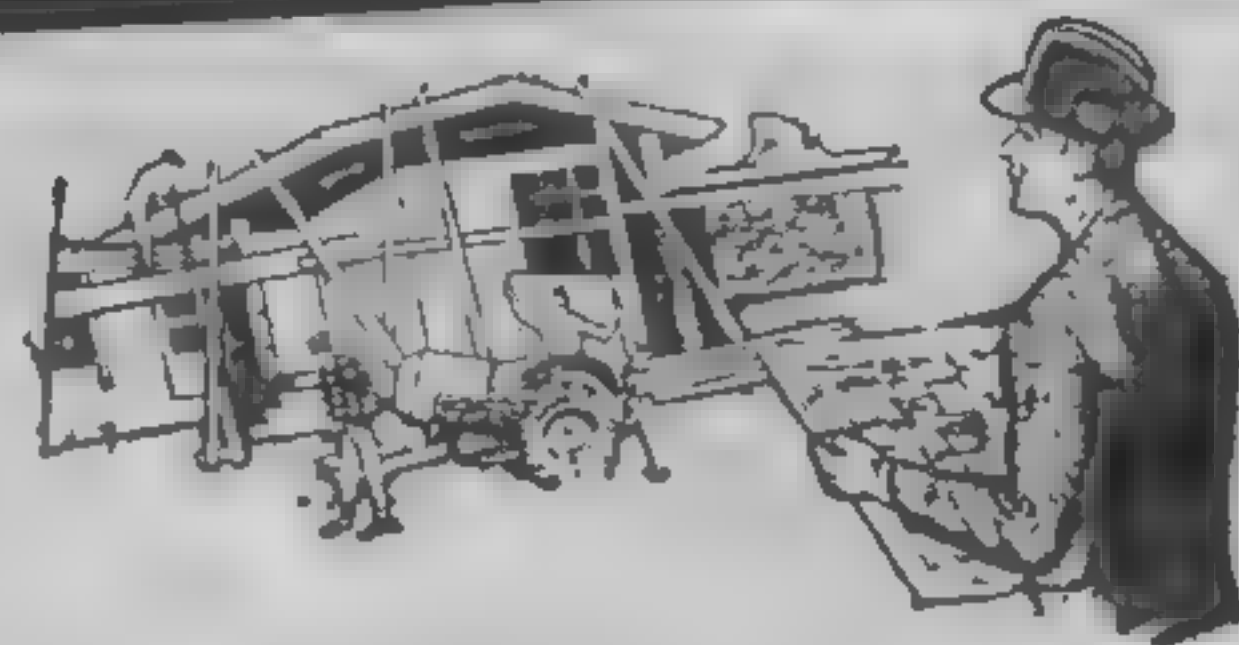


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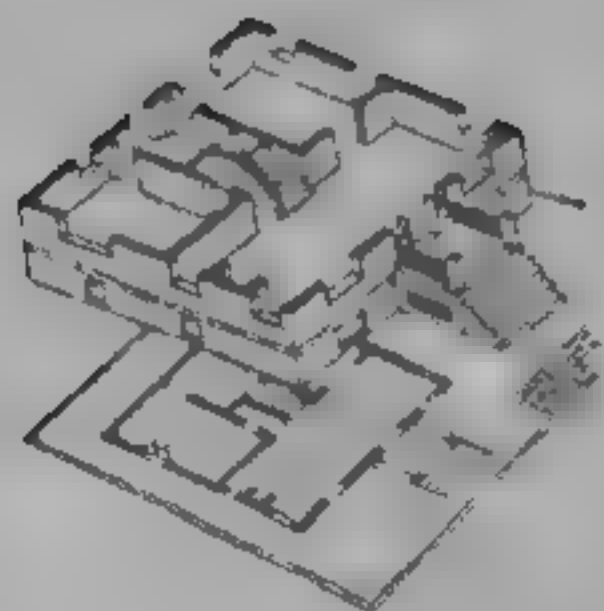
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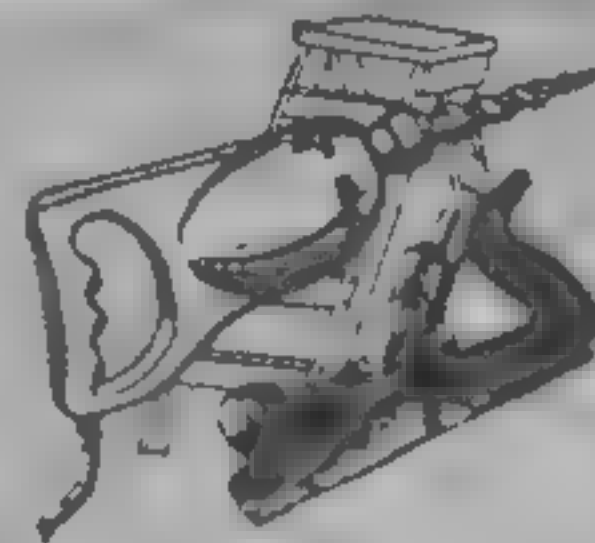


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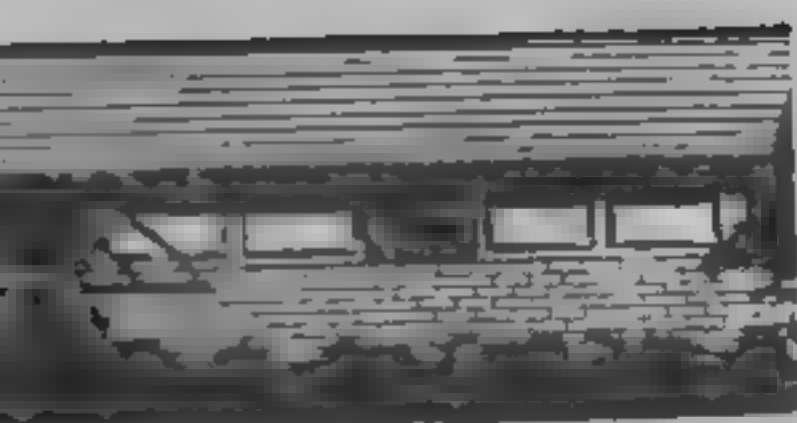


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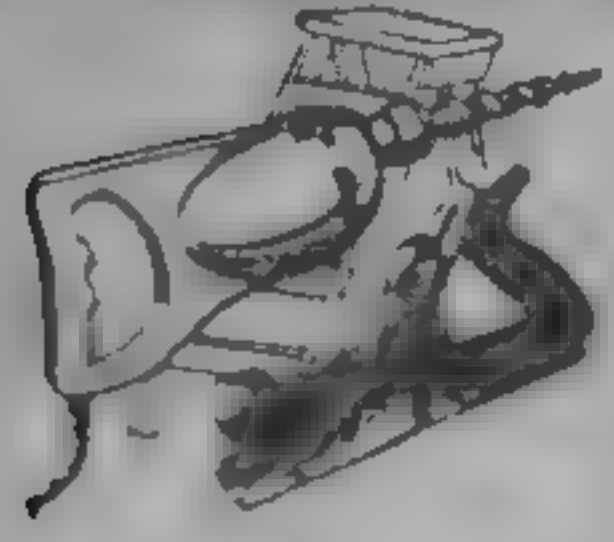
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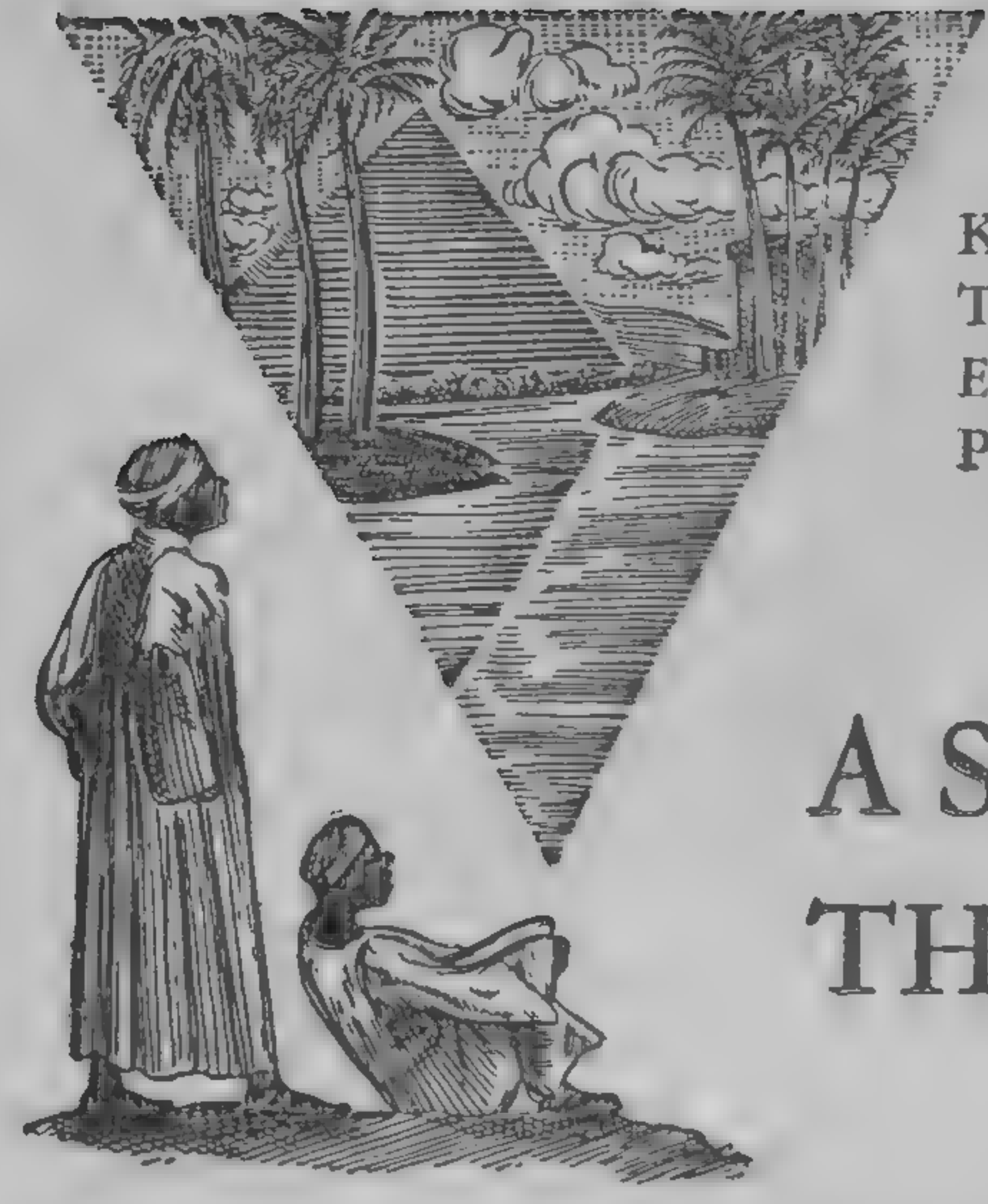
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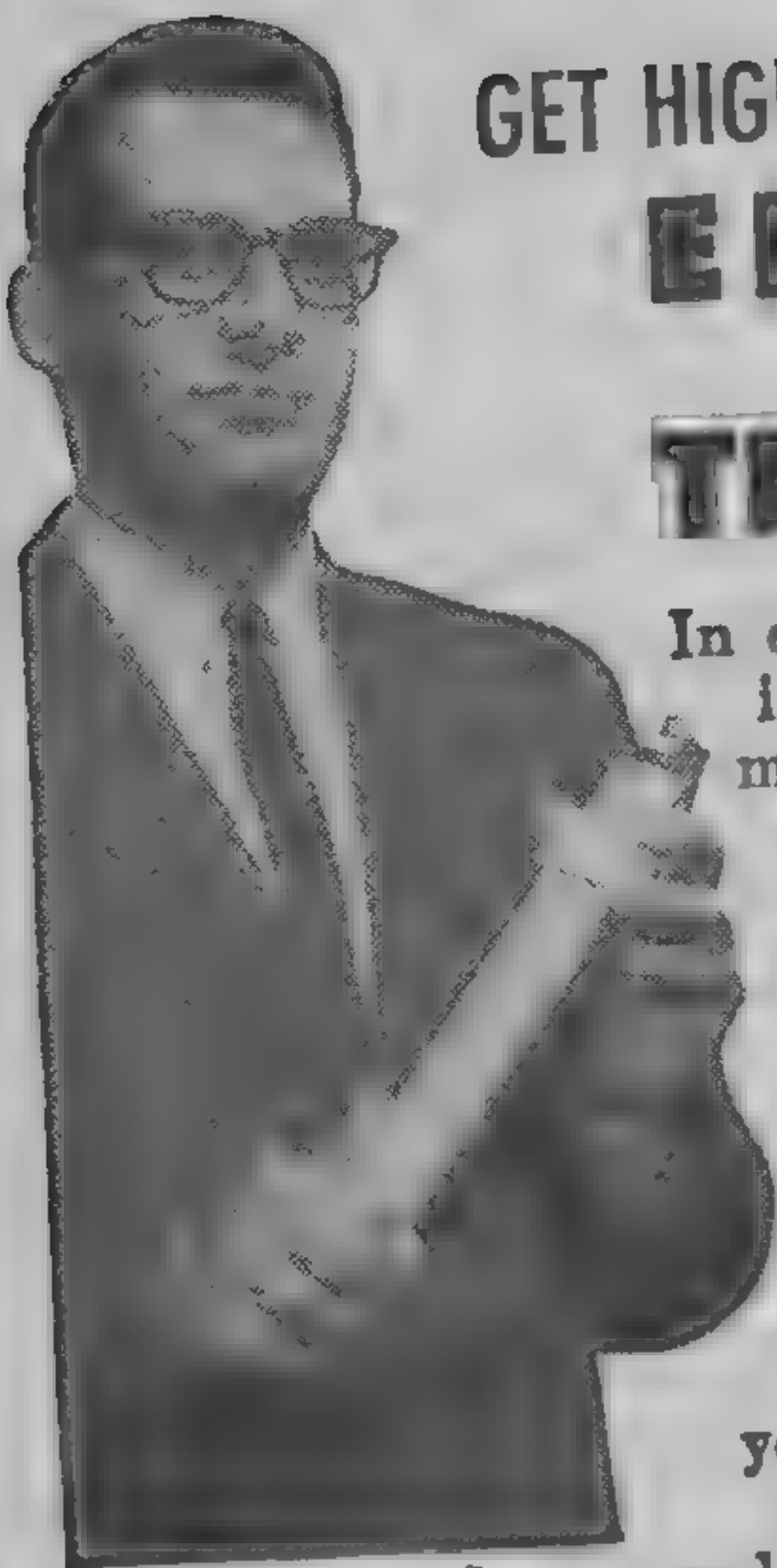
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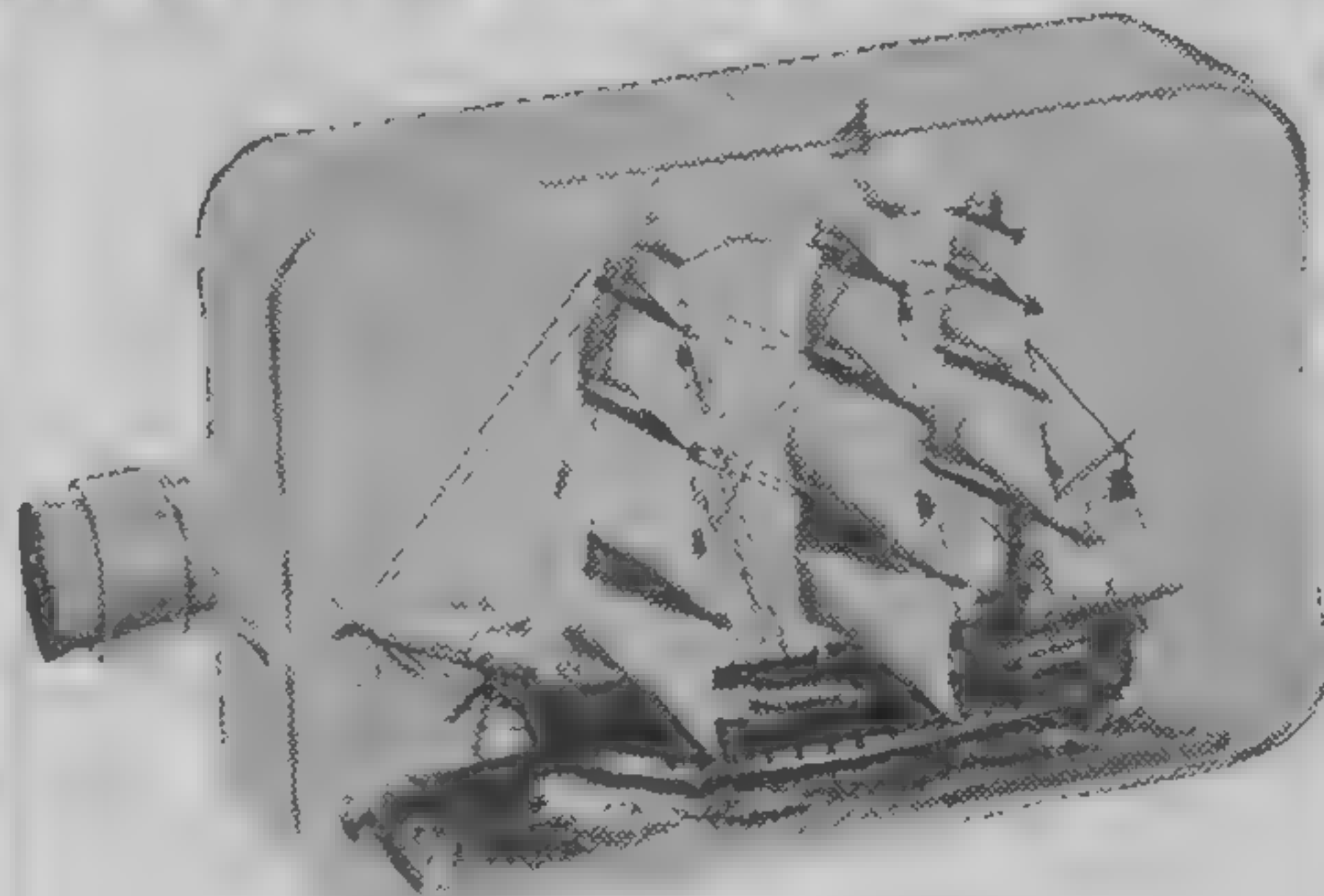
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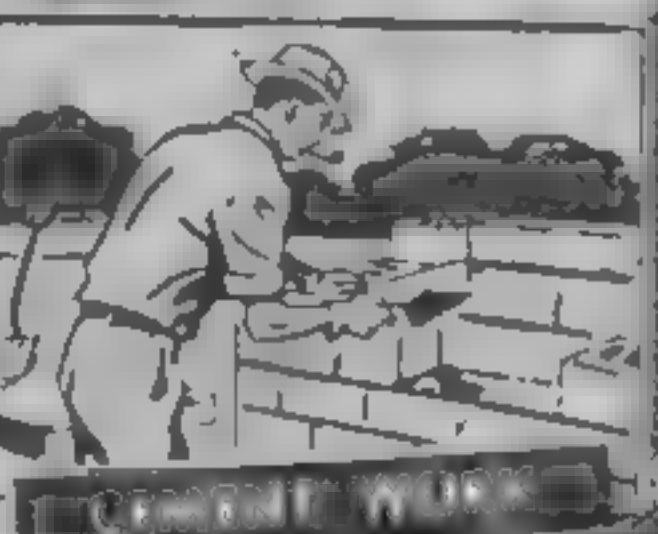
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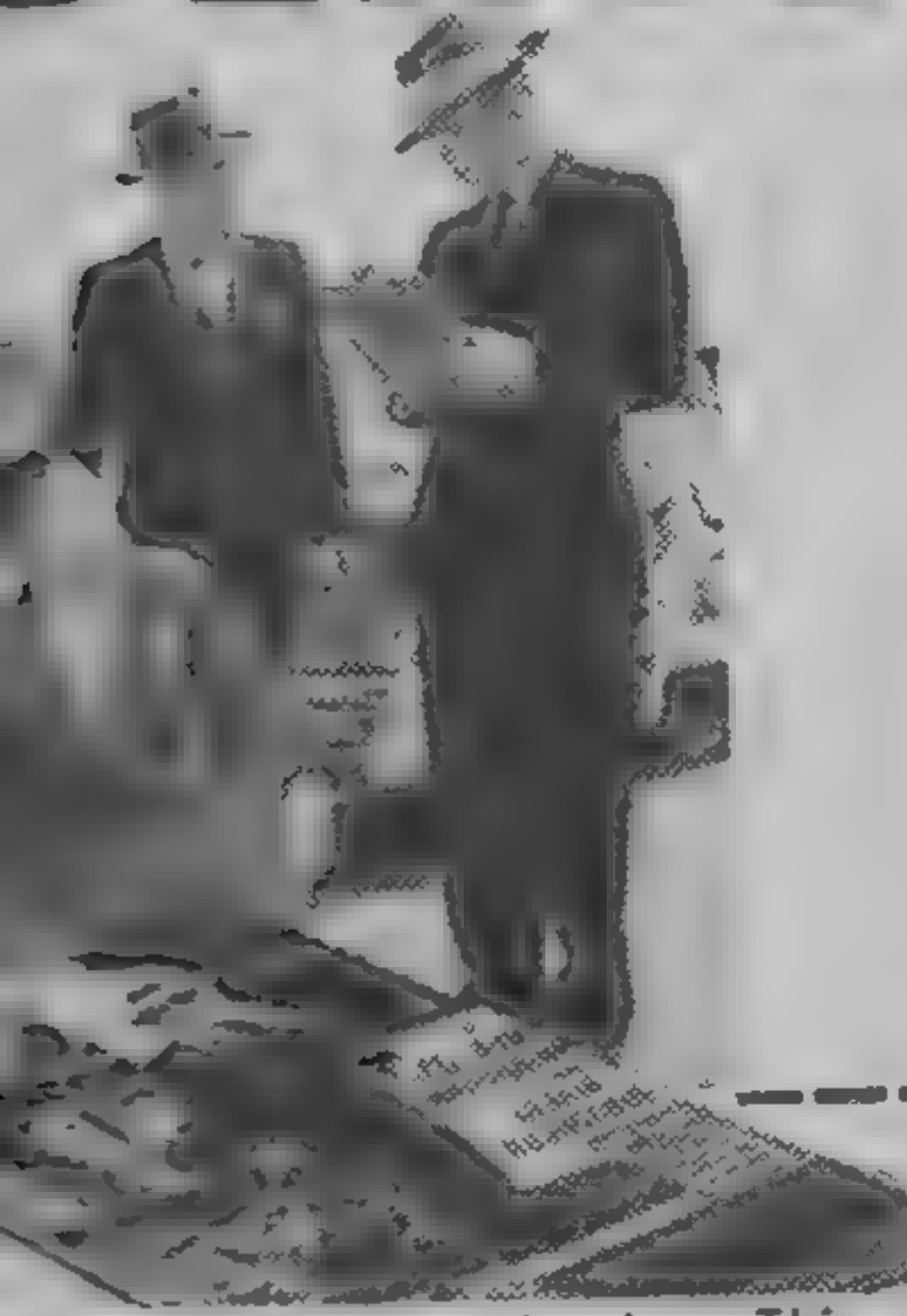
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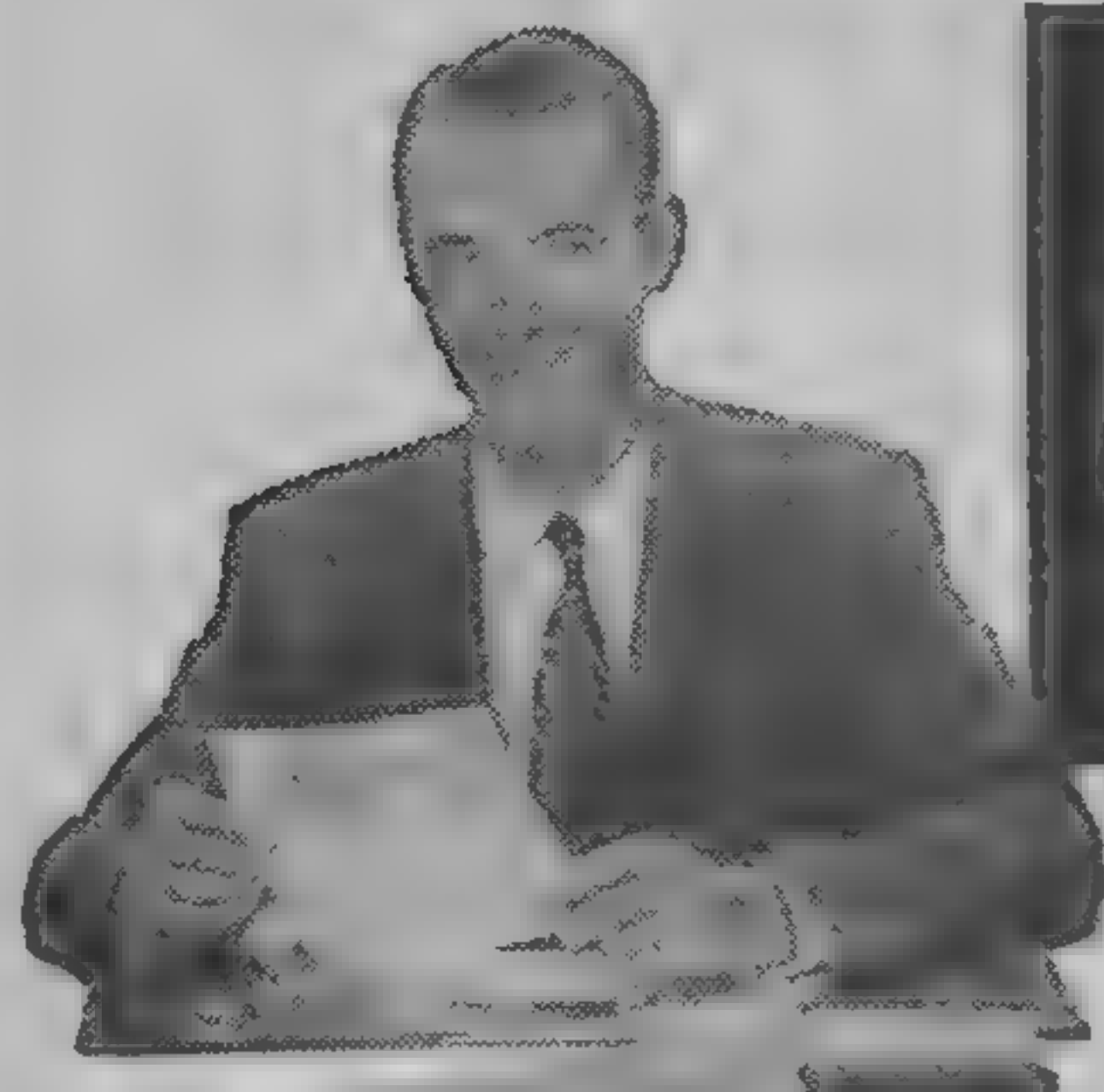
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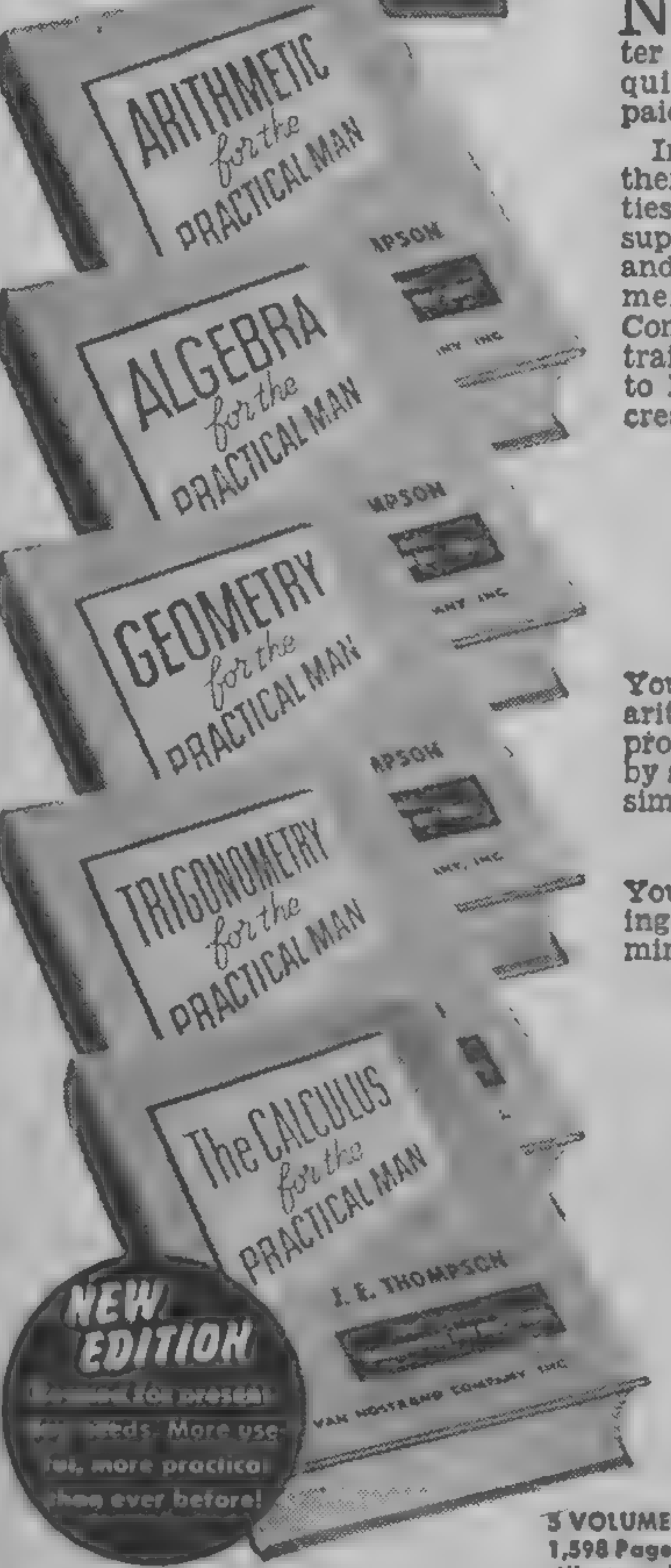
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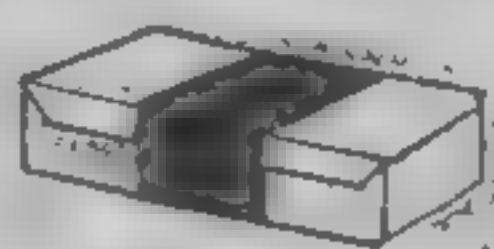
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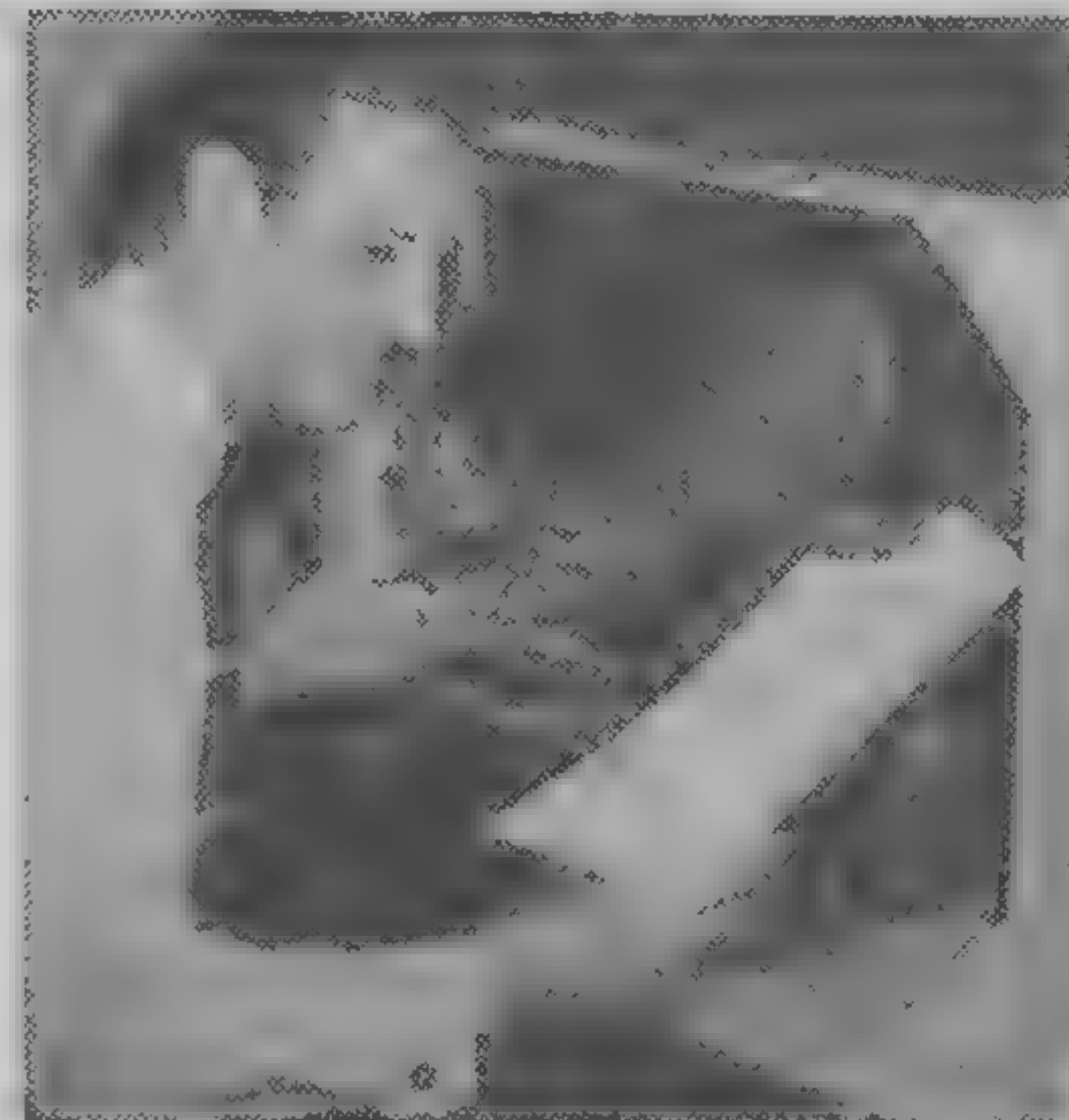
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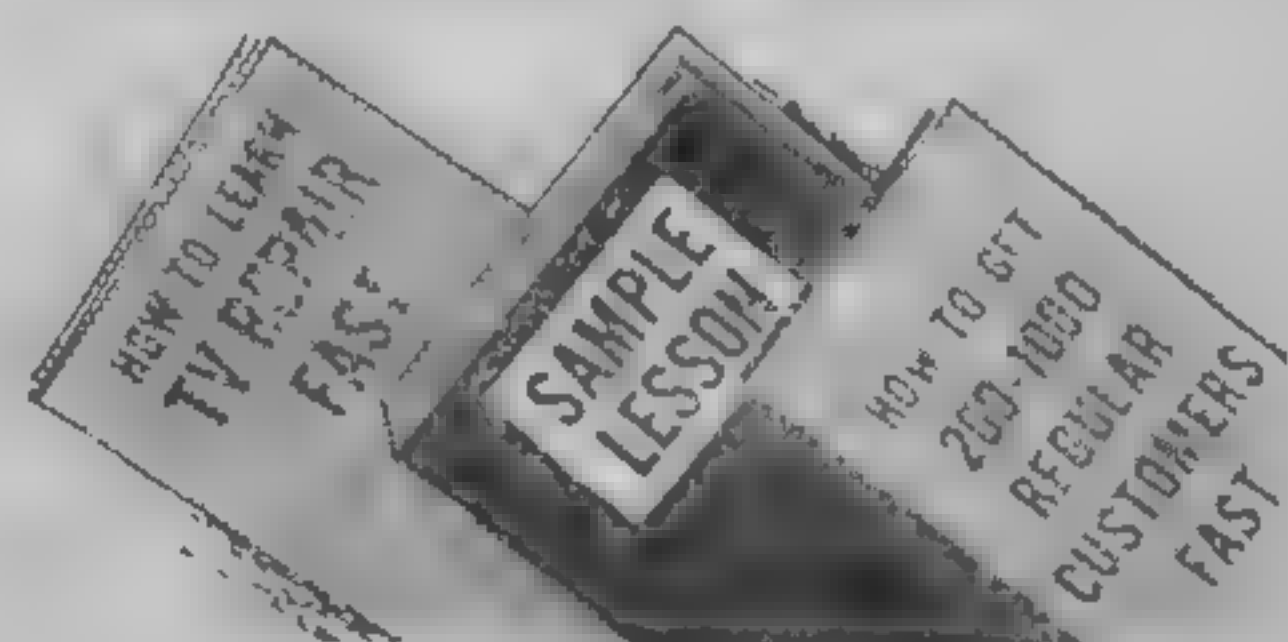
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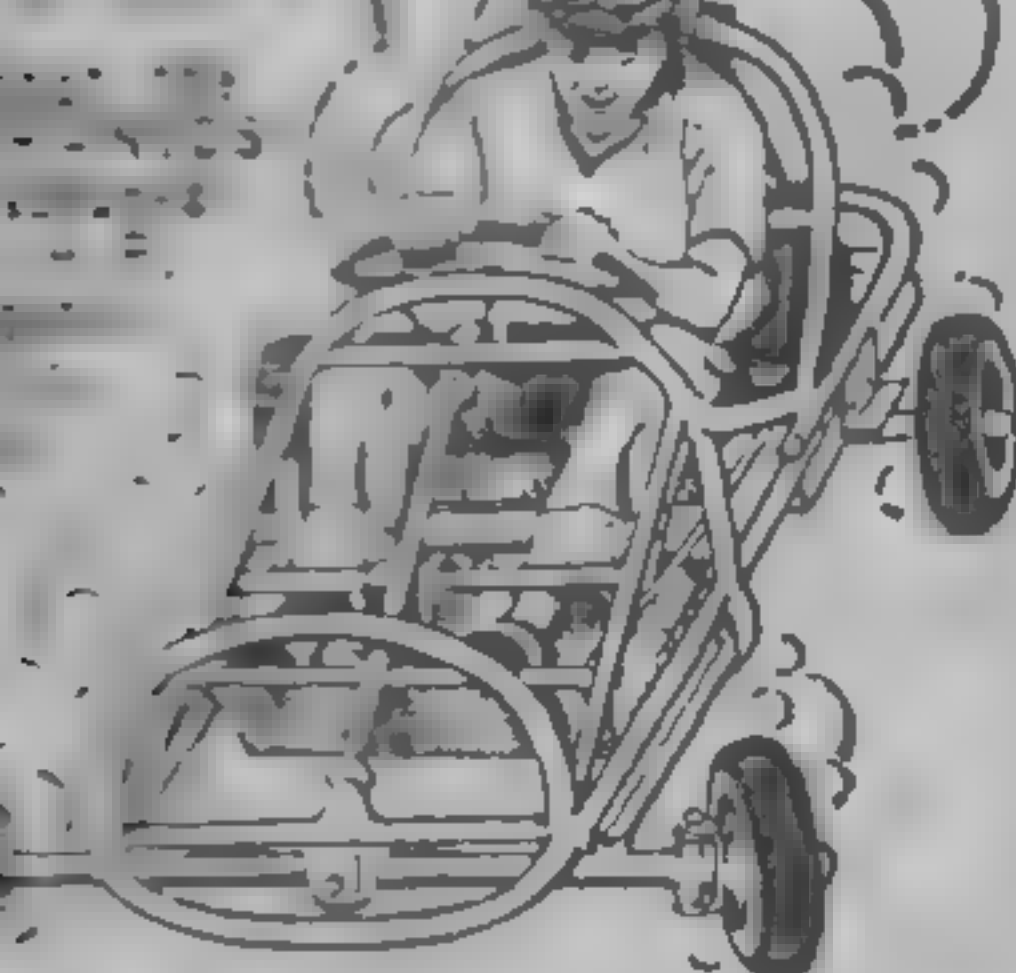
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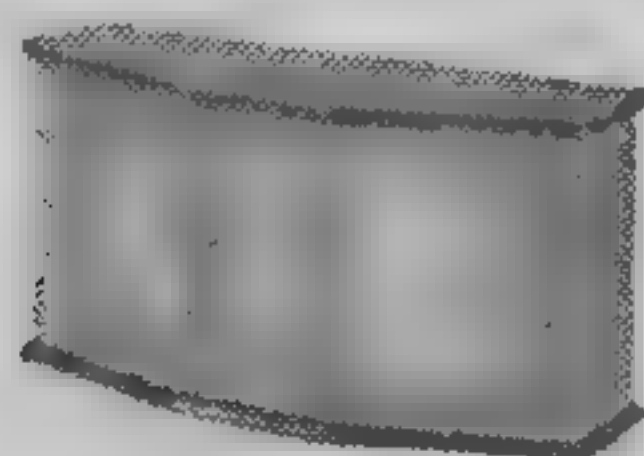
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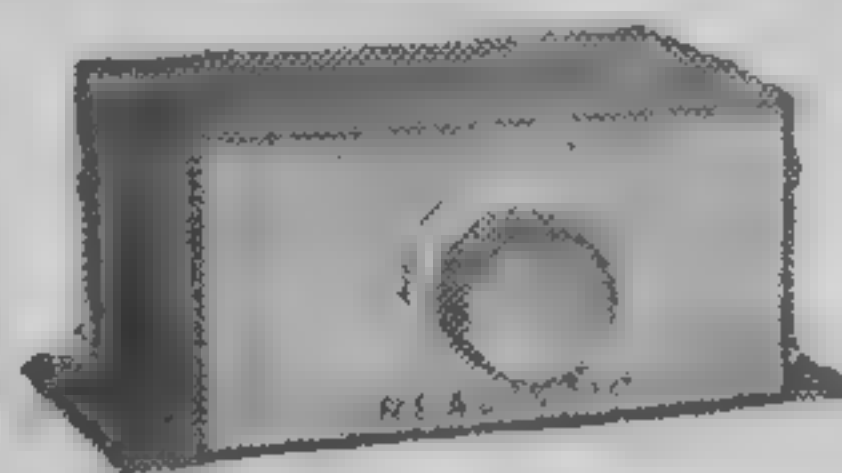
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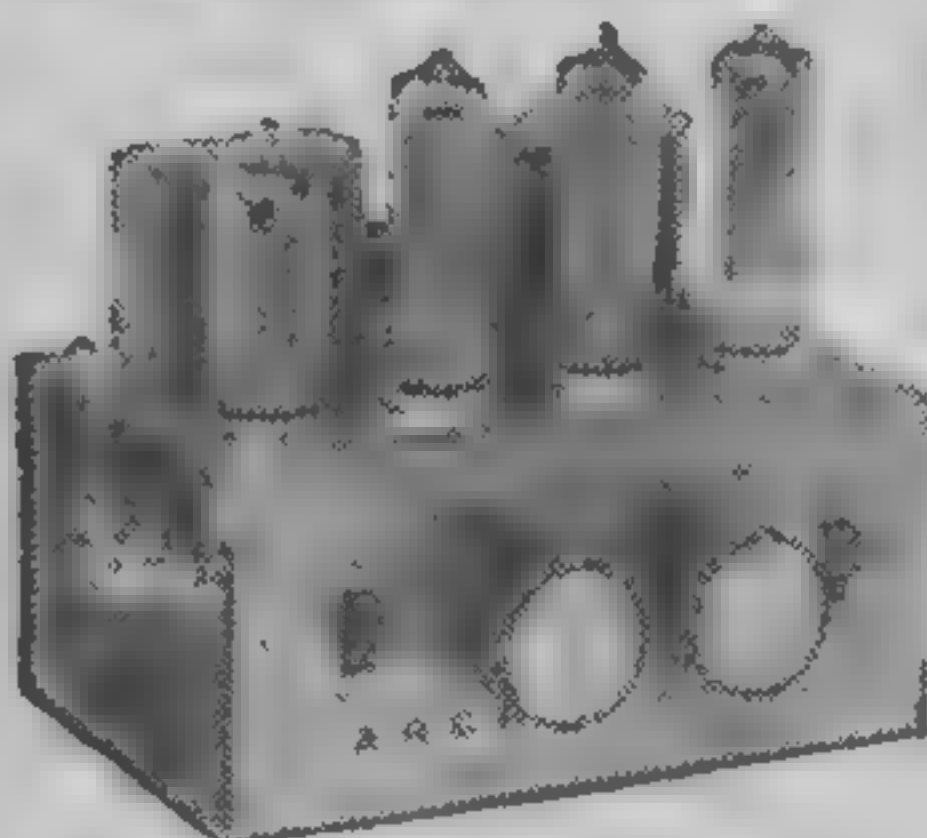
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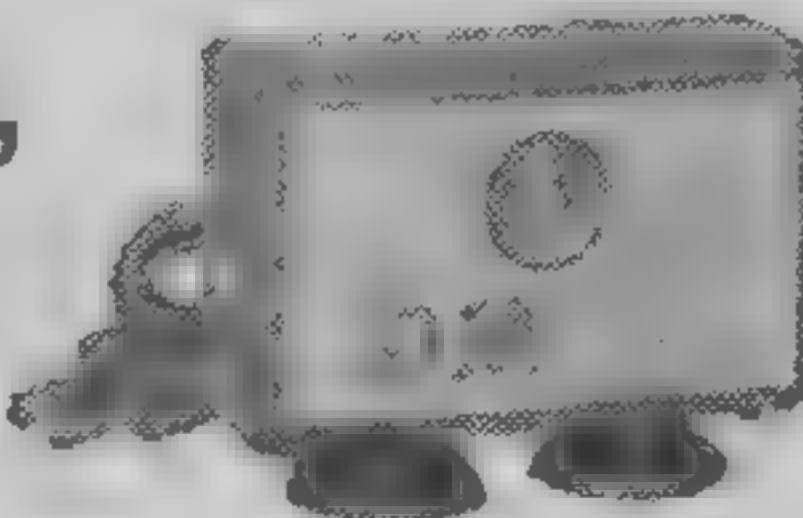
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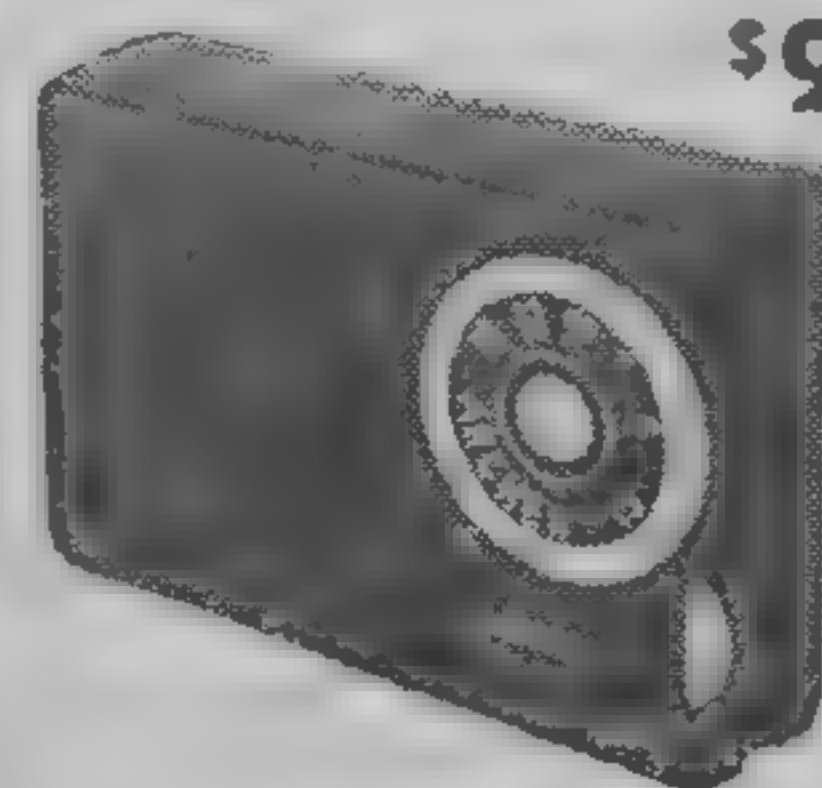
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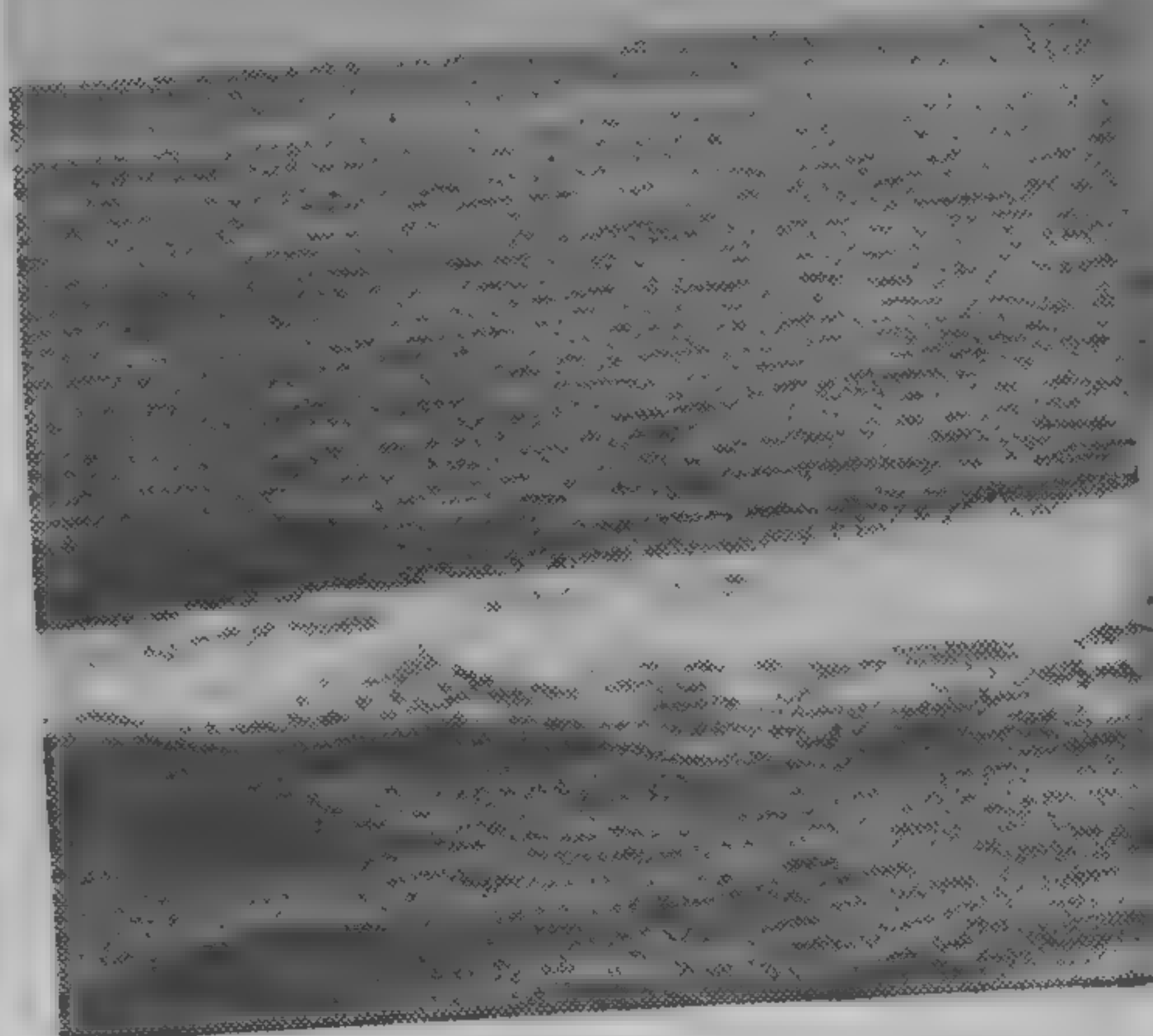
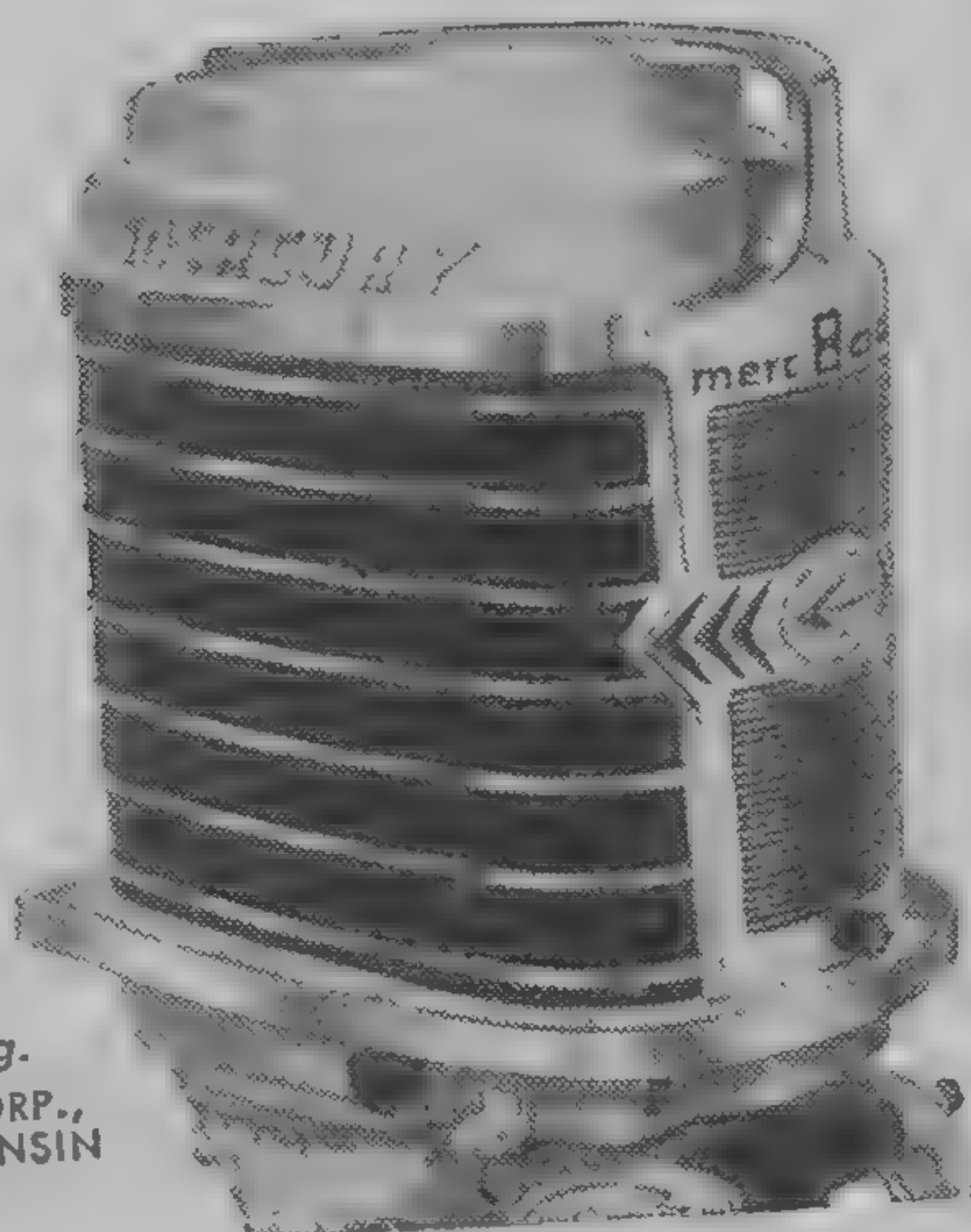
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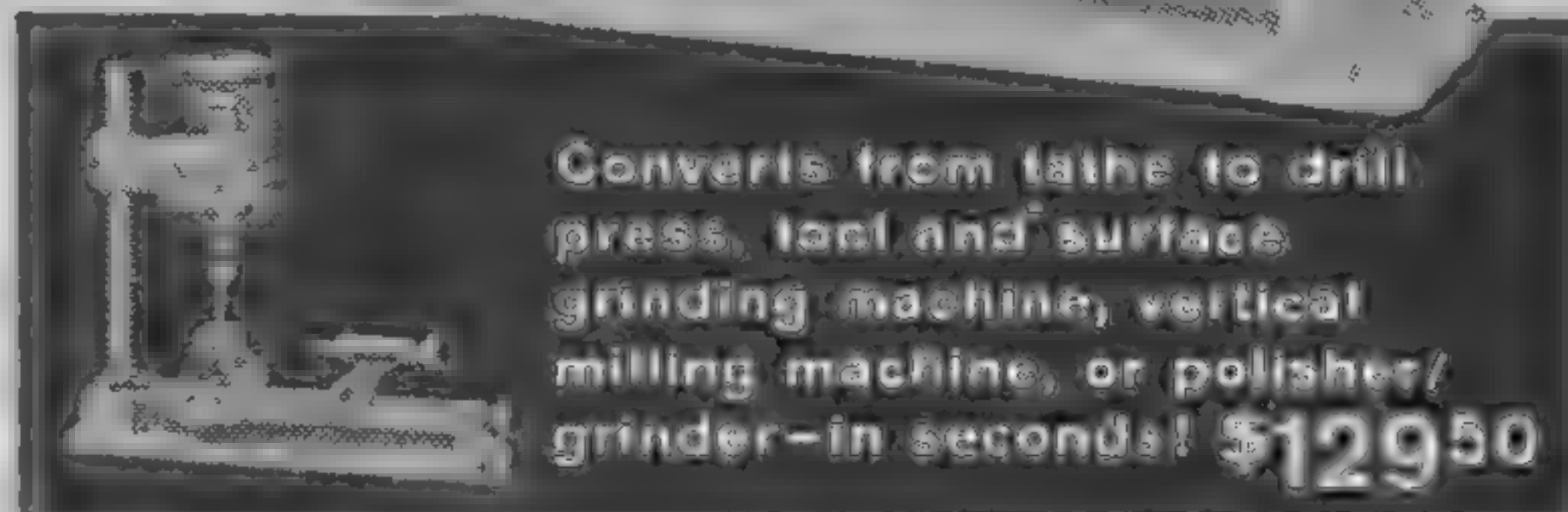
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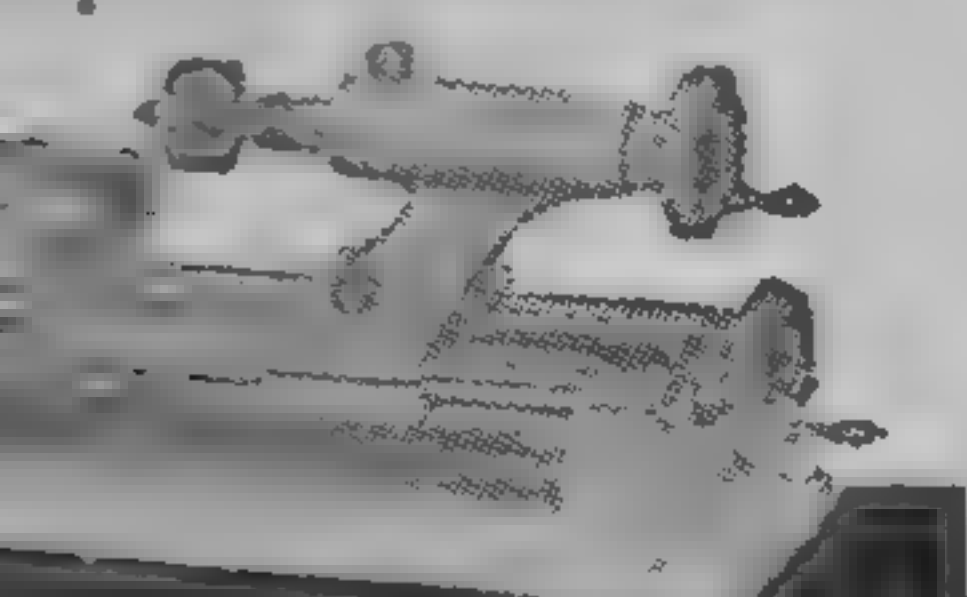
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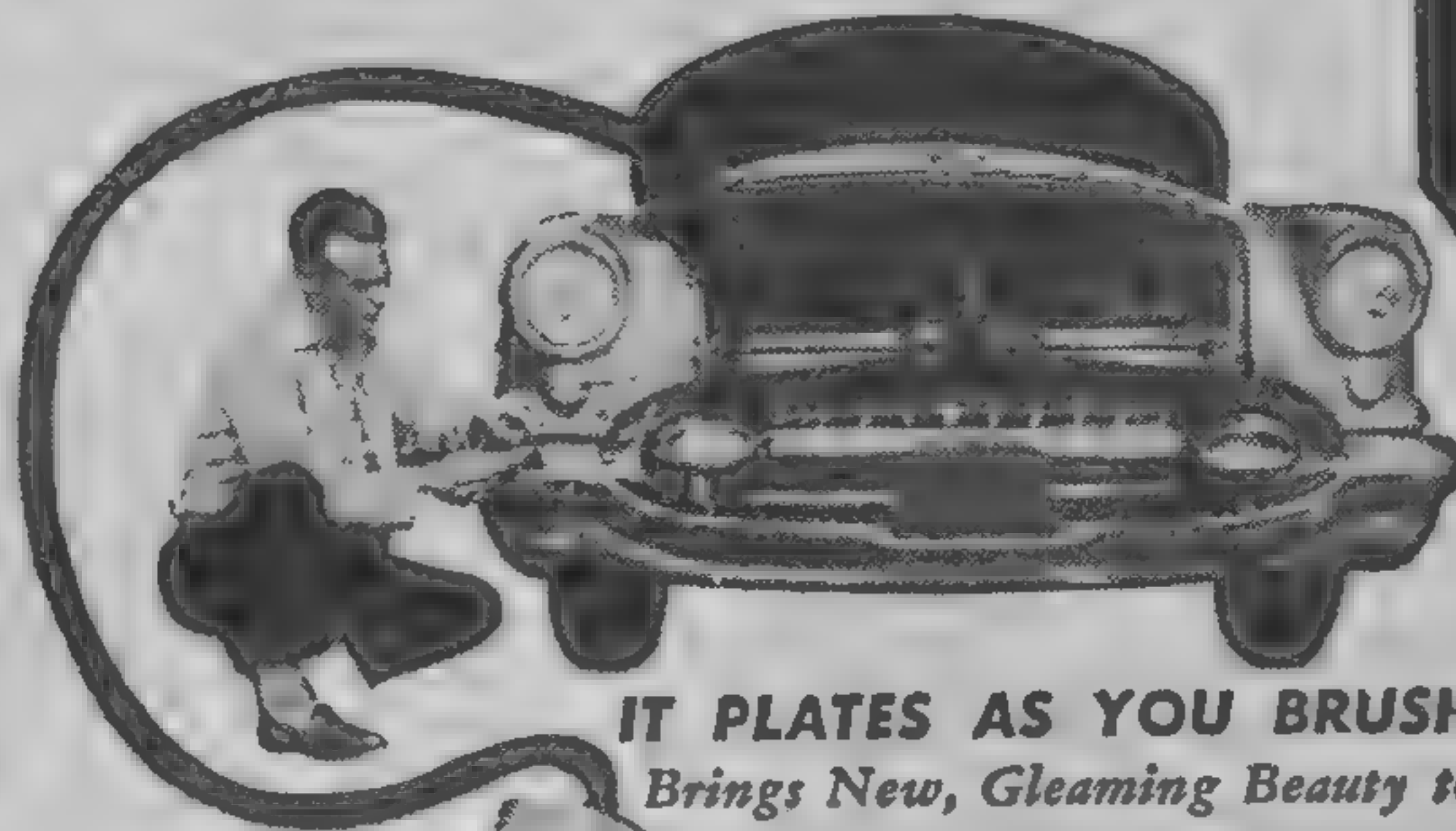
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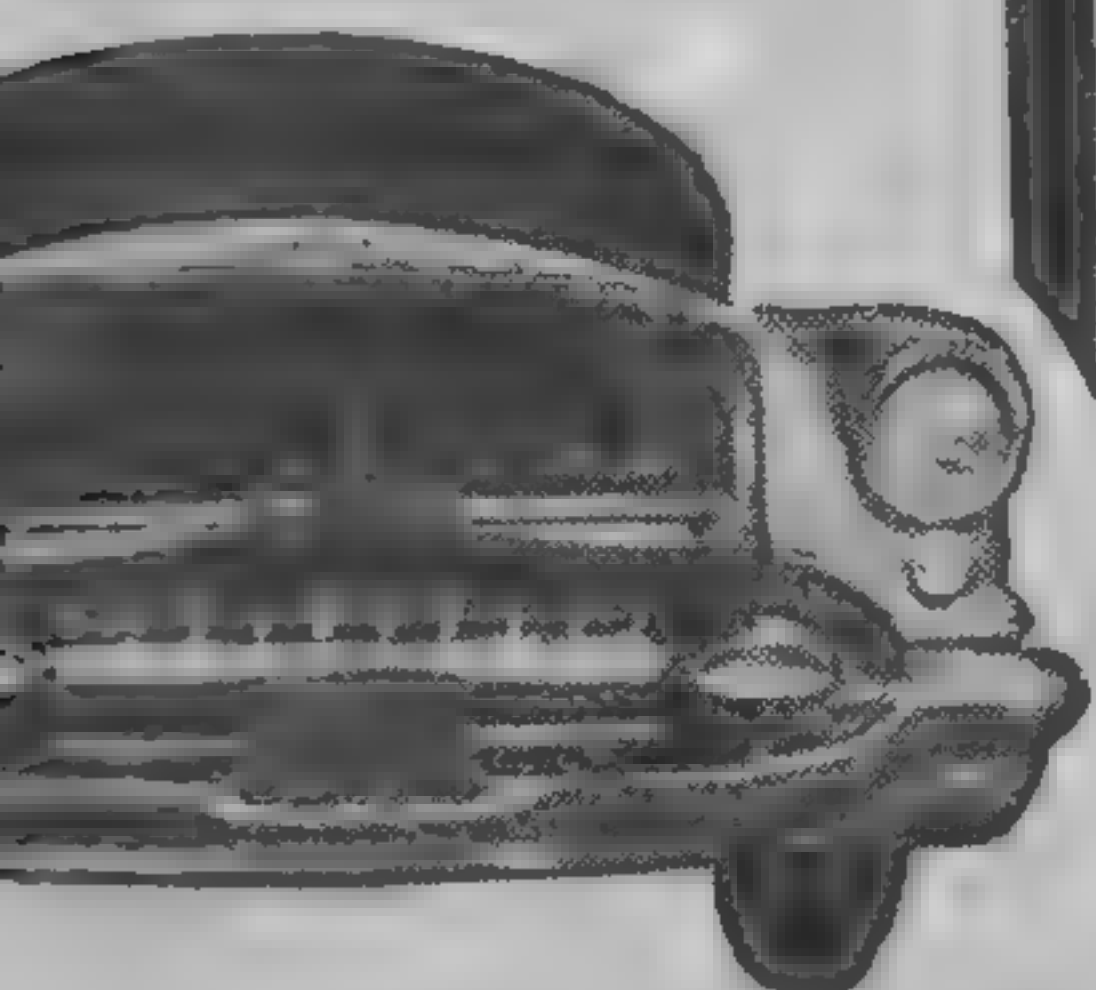
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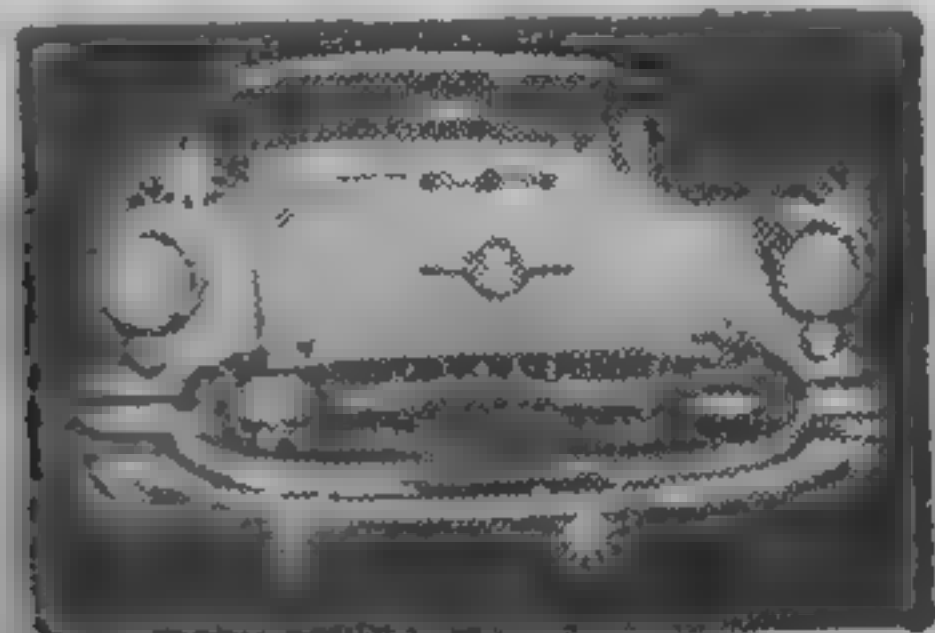
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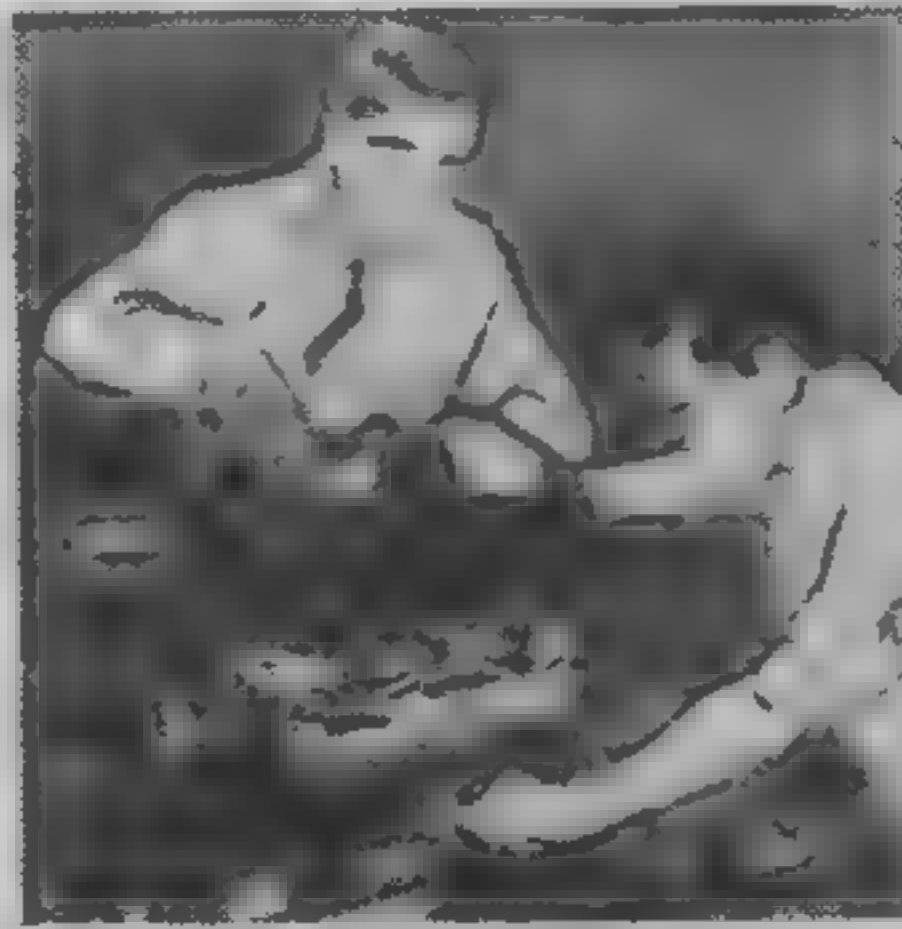
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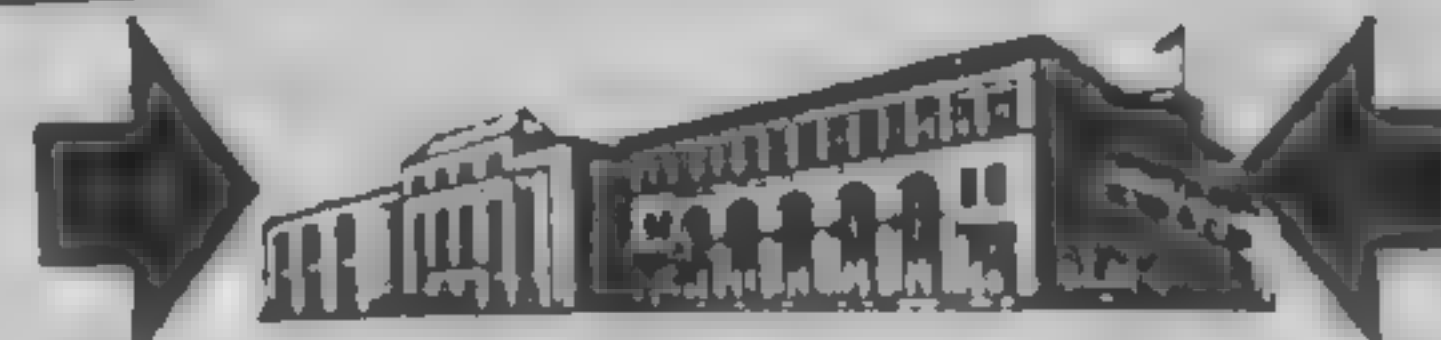
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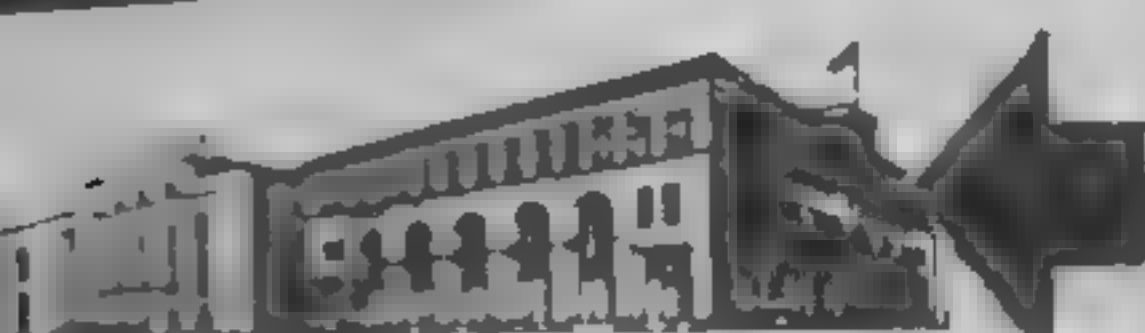
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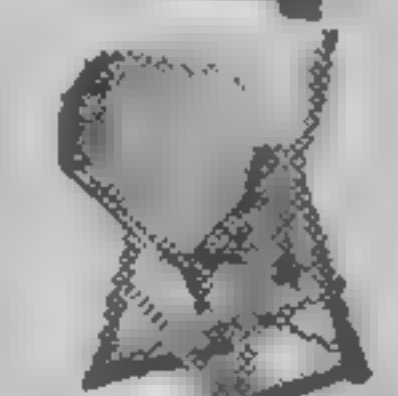
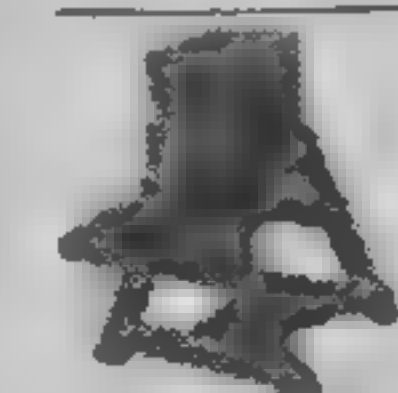
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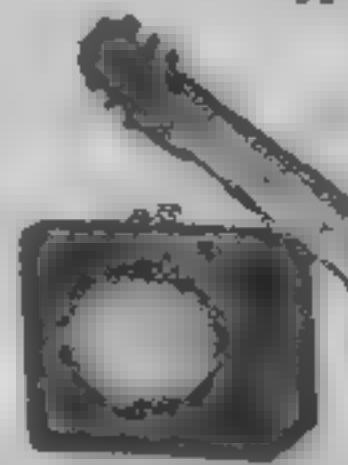
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The S
A "Must"
seeking B
... Can Y

CASE #1 Jones
ance and mailed it. Jones g
to that effect. Jones g
Smith to the contract

ANSWER: Yes. Both S
learning the acceptance

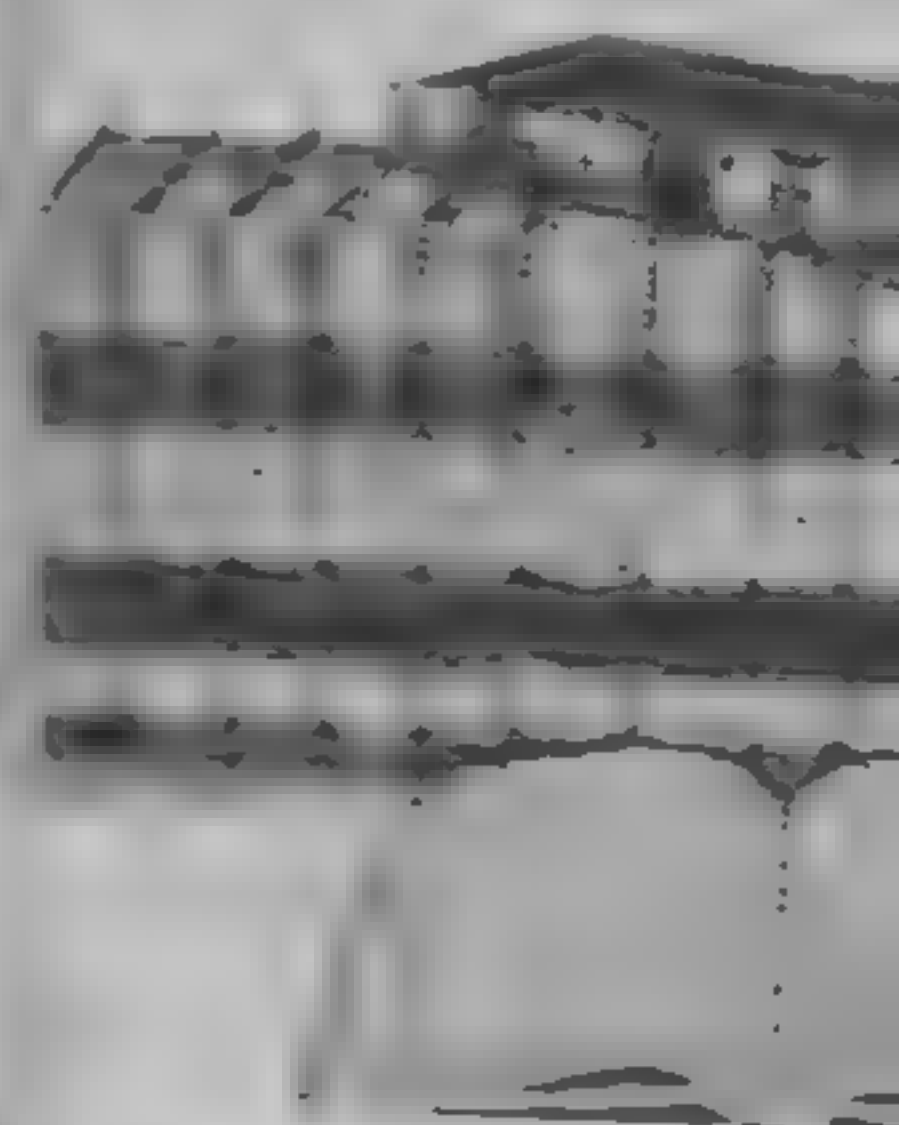
CASE #2 Doe sa
at \$50," Crane said,
unsettled, said nothing
for \$4,500. May he h

ANSWER: No. Crane

Law... A F
AND A L

Law today is involved in
of what our position
stands of ambitious m
practice are studying Law
a legal career but as an
Whether your work is
long, credit or collection
adjusting, merchandising
brokerage, manufacturing
stand and know Law.

The study of Law is a g
Many physicians, clergym
no studying Law with La
ad training, culture, as a r
Aside from the actual k
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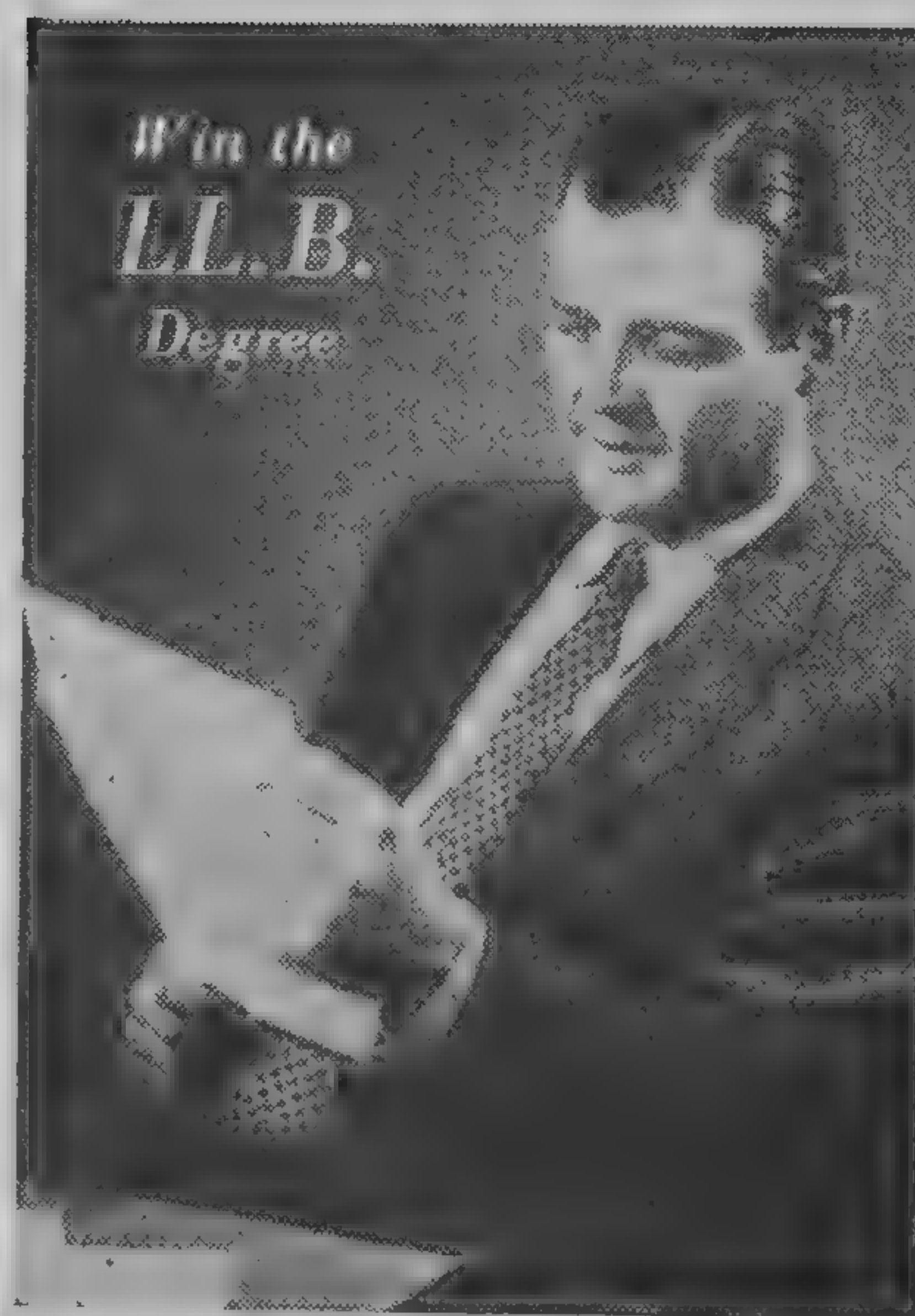
... Can YOU answer these legal problems?

CASE #1 Jones wrote Smith making an offer. Smith wrote his acceptance and mailed it. Then he decided to call it off and telegraphed Jones to that effect. Jones got the telegram before he did the letter. May he hold Smith to the contract?

ANSWER: Yes. Both Smith and Jones became bound when the letter containing the acceptance was mailed.

CASE #2 Doe said to Crane, "I will sell you 100 shares of XY stock at \$50." Crane said, "I'll give you \$45." Doe, knowing the market was unsettled, said nothing, but an hour later tendered 100 shares and a bill for \$4,500. May he hold Crane?

ANSWER: No. Crane's counter-offer was a rejection of Doe's offer.



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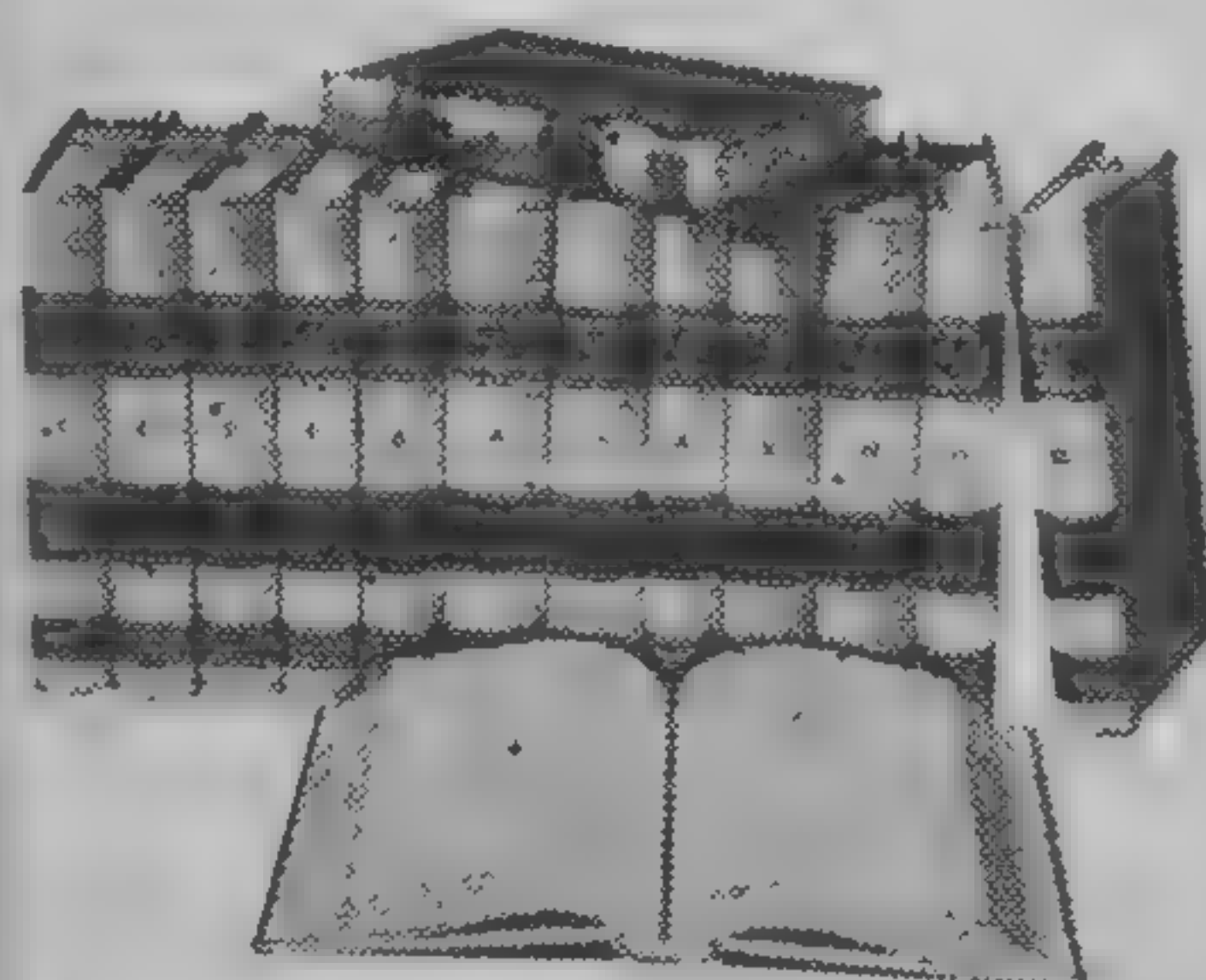
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DURING a recent interview with Don Bolander, Career Institute of America, a leading authority on career education, said, "You go back to school, learn to speak and write, graduate. You can do it quickly and easily. The privacy of your own home. The Career Institute of America has the answers to the questions, Bolander tells me, be done."

Question: What is the best way to learn to speak and write?

Answer: People judge you the way you speak. Poor English weakens your self-confidence—in your dealings with people. Good English is absolutely necessary to get ahead in business and life. You can't win and complete command of good other persons with command of good

Question: What do you mean by a "command of English"?

Answer: A command of English means you can express your ideas clearly and easily, without any of embarrassment or mistakes. It means you write well, carry on conversation—also and remember what you say. Good English can get you off self-doubt and holding you back.

Question: But isn't it hard for a person to go to school to gain a command of English?

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*"It's easy," says Don Bolander . . .
"and you don't have to go back to school!"*

How to Speak and Write Like a College Graduate

DURING a recent interview, Don Bolander, director of Career Institute of Chicago and a leading authority on adult education, said, "You don't have to go back to school in order to speak and write like a college graduate. You can gain the ability quickly and easily in the privacy of your own home through the Career Institute Method." In his answers to the following questions, Bolander tells how it can be done.

Question: *What is so important about a person's ability to speak and write?*

Answer: People judge you by the way you speak and write. Poor English weakens your self-confidence—handicaps you in your dealings with other people. Good English is absolutely necessary for getting ahead in business and social life. You can't win the respect and complete confidence of other persons without a sure command of good English.

Question: *What do you mean by a "command of English"?*

Answer: A command of English means you can express yourself clearly and easily without fear of embarrassment or making mistakes. It means you can write well, carry on a good conversation—also read rapidly and remember what you read. Good English can help you throw off self-doubts that may be holding you back.

Question: *But isn't it necessary for a person to go to school in order to gain a command of good English?*

Answer: No, not any more. You can gain the ability to speak and write like a college graduate right in your own home—in only a few minutes each day.

Question: *Is this something new?*

Answer: Career Institute of Chicago has been helping people for many years. The Career Institute Method quickly shows you how to stop making embarrassing mistakes, enlarge your vocabulary, develop your writing ability, discover the "secrets" of interesting conversation.

Question: *Does it really work?*

Answer: Yes, beyond question. In my files there are thousands of letters, case histories and testimonials from people who have used the Career Institute Method to achieve amazing success in their business lives.

Question: *Who are some of these people?*

Answer: Almost anyone you can think of. The Career Institute Method is used by men and women of all ages. Some have attended college, others high school, and others only grade school. The method is used by business men and women, typists and secretaries, teachers,

industrial workers, clerks, ministers, and public speakers, housewives, sales people, accountants, foremen, writers, foreign-born citizens, government and military personnel, retired people, and many others.

Question: *How long does it take for a person to gain the ability to speak and write like a college graduate, using the Career Institute Method?*

Answer: In some cases people take only a few weeks to gain a command of good English. Others take longer. It is up to you to set your own pace. In as little time as 15 minutes a day, you will see quick results.

Question: *How may a person find out more about the Career Institute Method?*

Answer: I will gladly mail a free 32-page booklet to anyone who is interested.

If you would like a free copy of the 32-page booklet, "How to Gain a Command of Good English," just mail the coupon below. The booklet explains how the Career Institute Method works and how you can gain the ability to speak and write like a college graduate quickly and enjoyably at home.

DON BOLANDER

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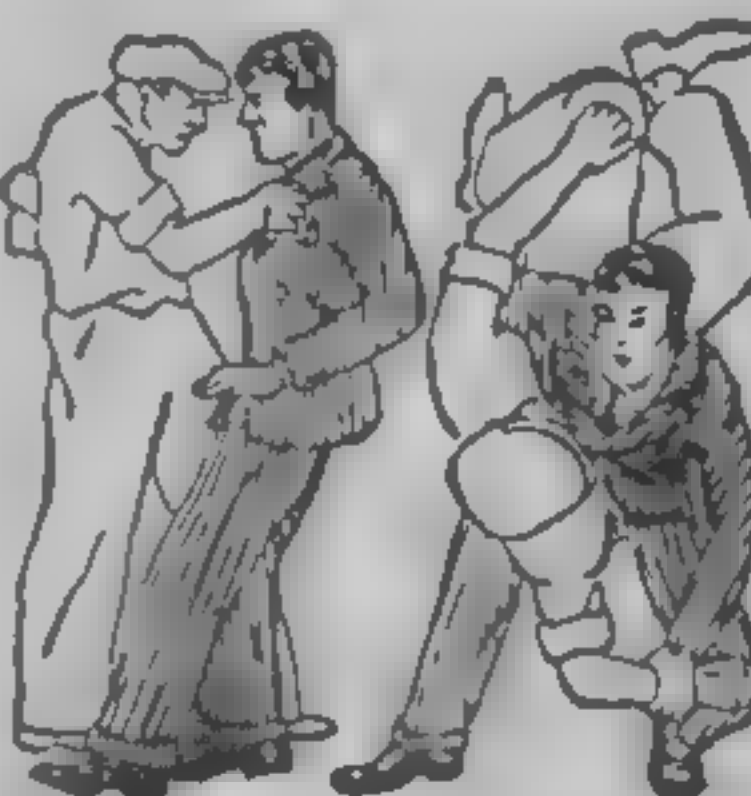
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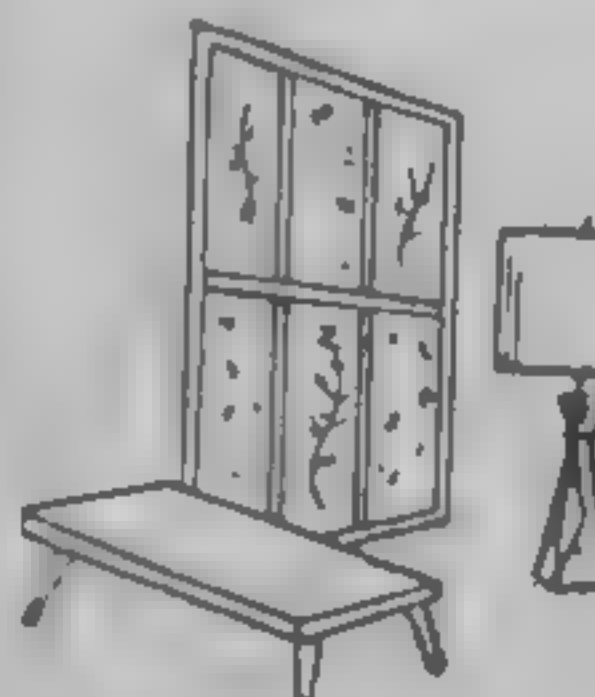


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Your job pays well, but not quite enough to meet all your needs. So you put in extra hours or take on part-time work to pay a few pressing bills. This is no long-range solution to your problem and you are only too well aware of it. Instead of meeting financial emergencies with temporary measures that lead nowhere, begin now to build a business with a future and earn a SECOND INCOME with SECURITY.

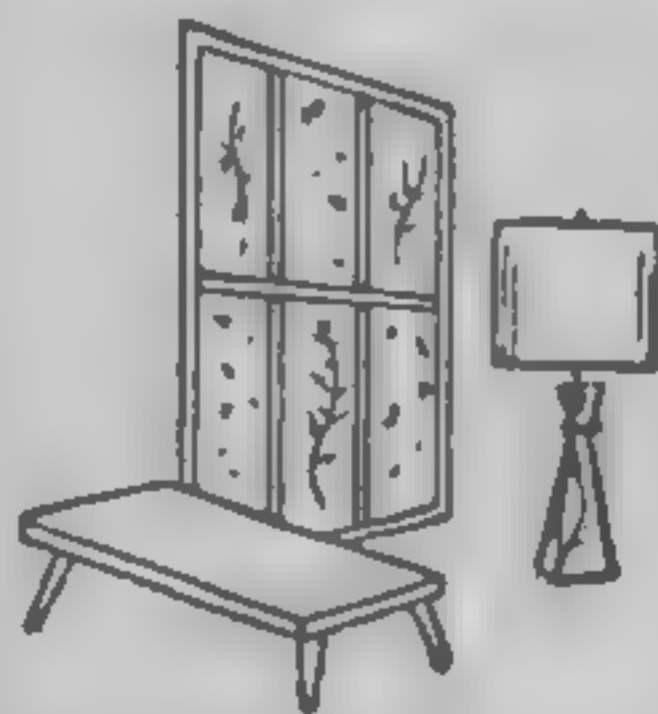
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Here you are—with a pair of skilled hands and a head full of ideas and a wife who can match your talents in her own way. In your home shop are tools that stand idle most of the time since you put the finishing touches on your house. You, sir, are not unlike the owner of a factory who locks the door and goes down the street to work for a competitor. Have you locked the door to your opportunities? Your ideas—your skill in carrying them out—your wife's imagination and ingenuity, plus your workshop, are your factory, your capital. Are you making the most of them?



There Is A Ready-Made Market Waiting For You



"Selling isn't up my alley," you say. That's probably true of most craftsmen. But please remember that buyers for stores and mail order houses need products just as much as you need customers. Companies spend millions of dollars each year, sending their shoppers to gift fairs, craft shows and out-of-the-way art and craft centers in search of the unusual in new products. If you can make a quality item, and if you are able to supply the demand, you will find the buyers... or they will find you.

What Do People Want?

They want something NEW—something DIFFERENT. They want VALUE. Of course, there will always be a huge demand for the mass produced novelties. That's not for you! Big factories will meet that demand more economically, often sacrificing quality in the process. YOUR field is the new and rapidly growing market for unusual home accessories, handcrafted articles and novelties of good design and craftsmanship, jewelry that is distinctive—that stands out from the machine-made stuff. That's where you come in, and your wife, and the whole family.



"How To Earn Extra Money In Your Spare Time" Helps You Get Started From Scratch

In language that anybody can understand, it explains the simple rules and sound principles of operating a shop or studio for profit. Step-by-step it shows you...

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- How to sell it through stores or by mail order
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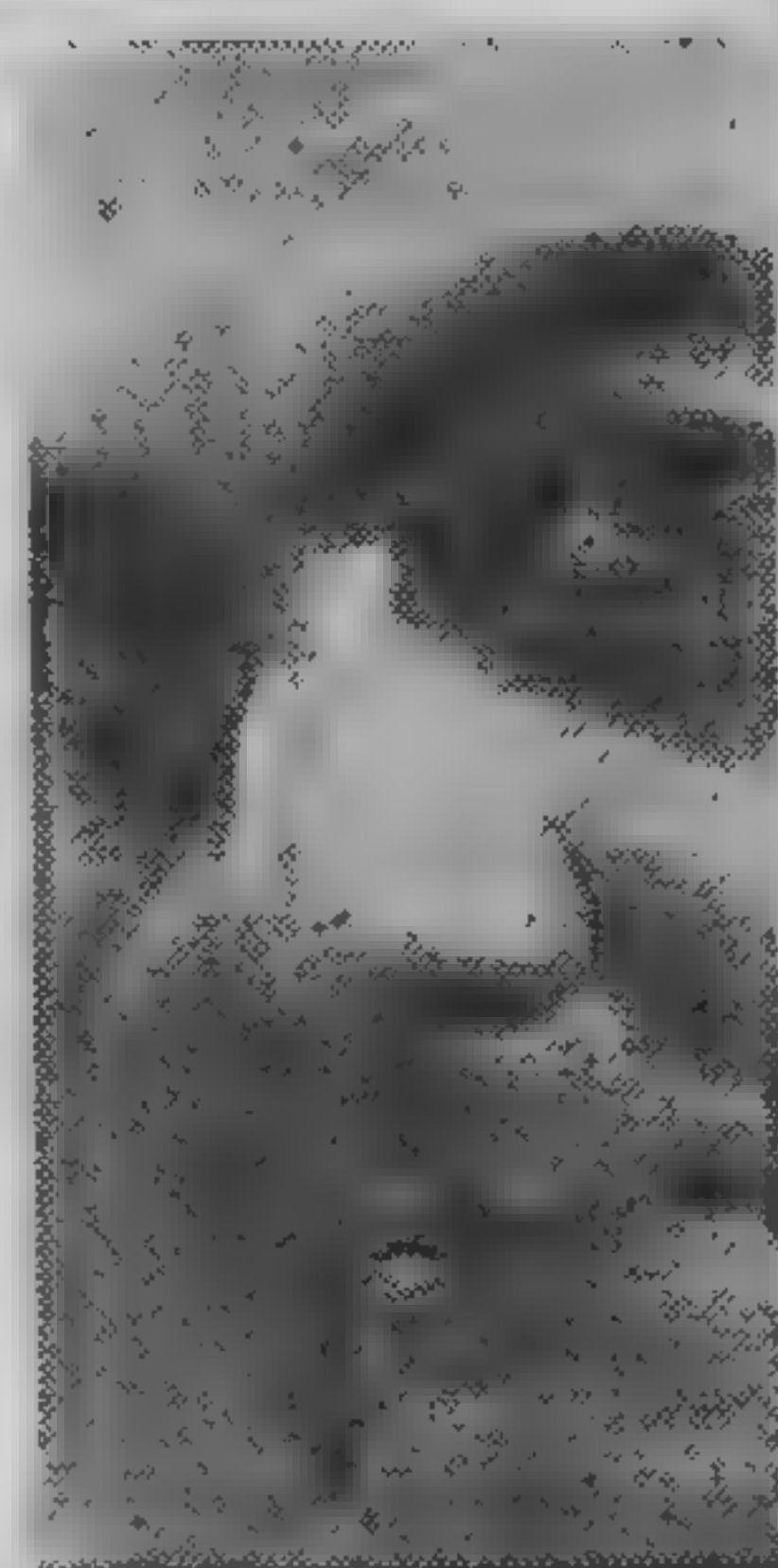
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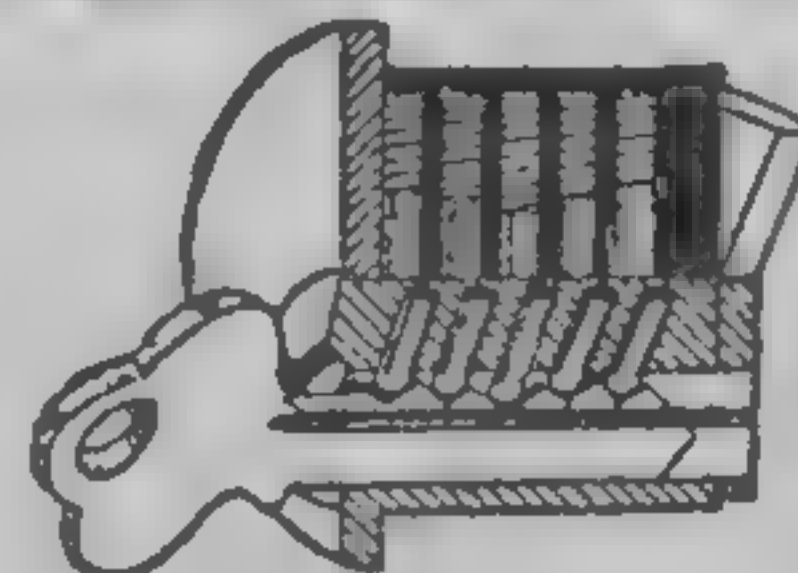
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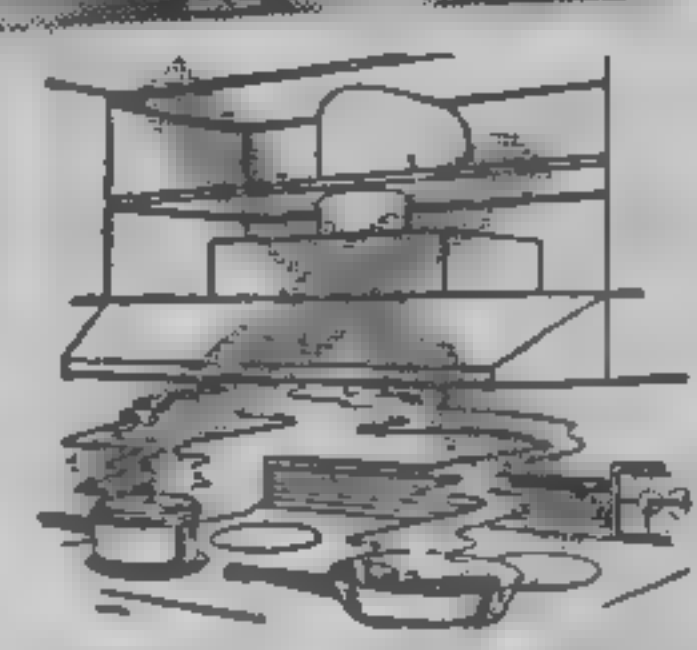
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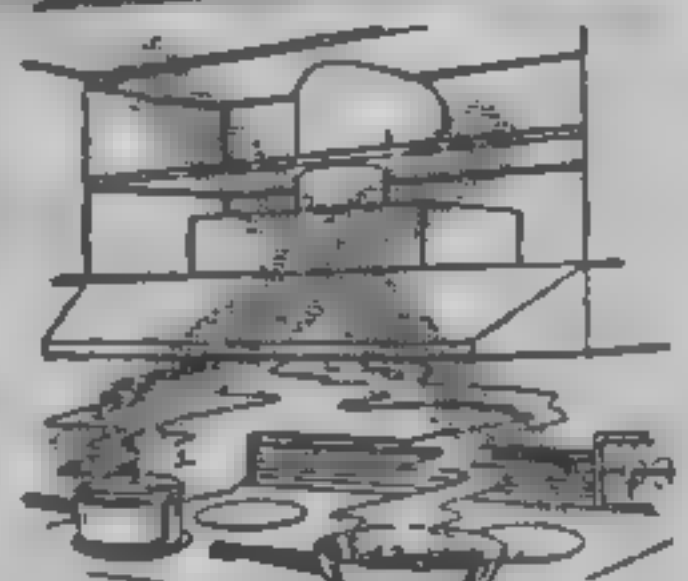


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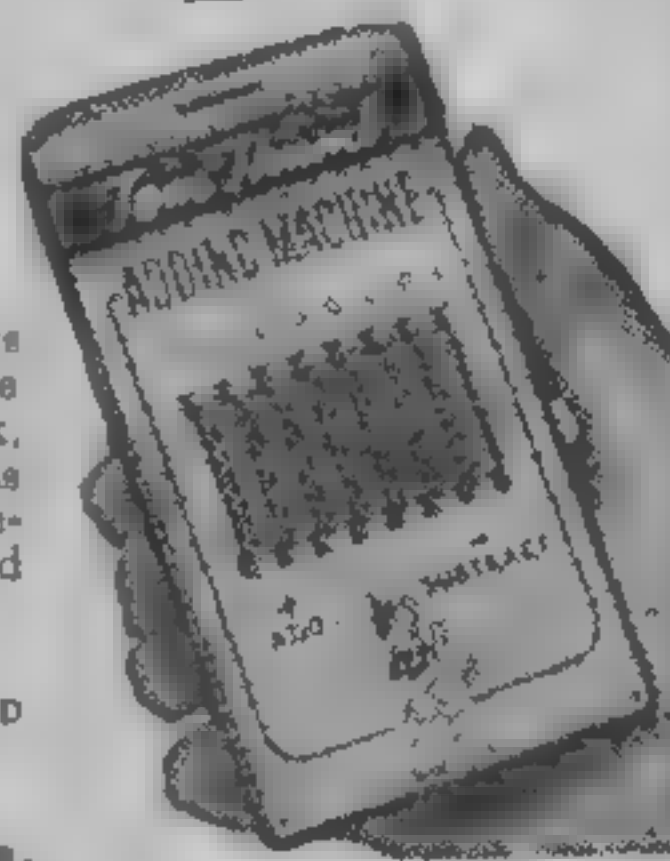
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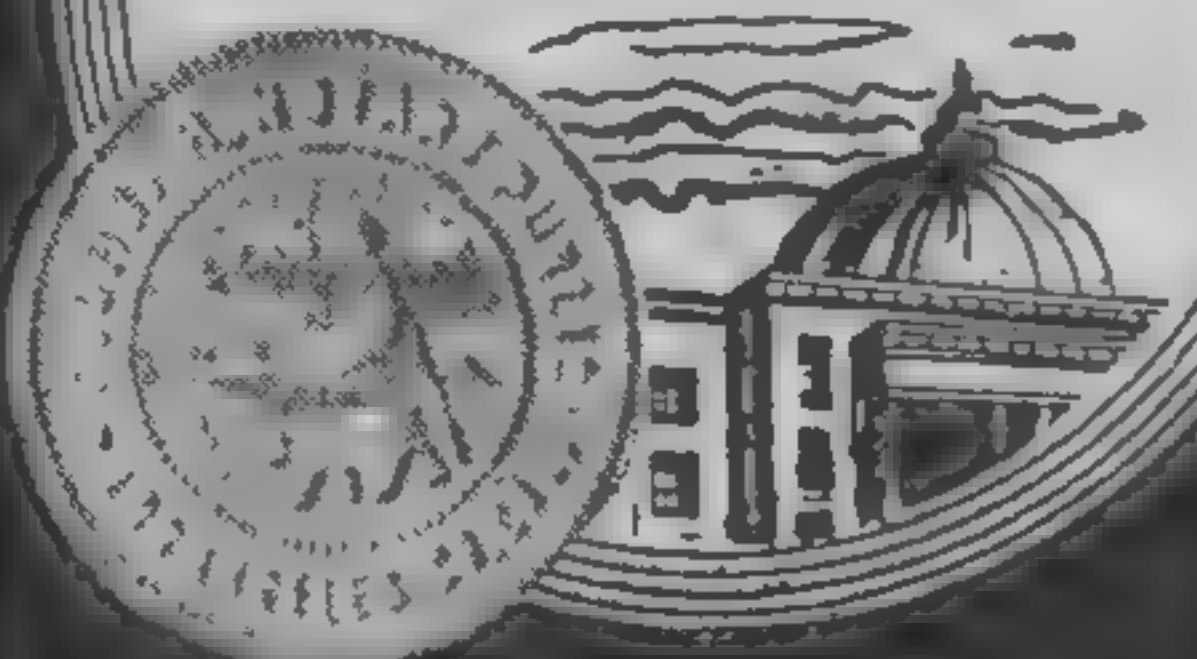
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Imagine—after only a few short days, you may
print many beautiful professional jobs for LESS
THAN IT WOULD COST ON A \$5000 PRINTING
PRESS!

SCREEN PRINTING IS FUN... EASY! If you like to
work with your hands and make beautiful things,
you'll find no Home Business that provides greater
enjoyment, relaxation, and PROFIT. You'll enjoy
every moment... creating beautiful printed mat-
erial that may sell for really BIG MONEY!

NO EXPERIENCE OR COSTLY EQUIPMENT NEEDED!
Few home businesses offer such BIG PROFITS for
so little time, money, or training! You don't need
art ability, expensive equipment, or previous ex-
perience! You start at home with little or NO
OVERHEAD. Yet you can print—almost immedi-
ately—on PAPER, GLASS, LEATHER, CLOTH—
ANYTHING! Work with all colors, even the vi-
brant new FLUORESCENT "Glow Colors" that
are in such big demand in advertising circles! It's
amazing—but true!

START SPARE TIME—ON A "SHOESTRING"! Use your
spare time to earn up to \$12.50 per hour, right from
the start. Earn 2 INCOMES INSTEAD OF ONE.
Print in your garage, basement, spare room—any-
where! Screen Printing requires little space—won't
interfere with your household set-up. Later, when
you see the TREMEN-
DOUS PROFITS to be
made, you may wish to
make Screen Printing your
full-time occupation. Be-
come your own boss—make
BIG MONEY! Others are
doing it—why can't you?



HELP FILL THE HUGE, GROWING DEMAND! Busi-
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—almost "overnight"—of the amazing quality and
economy of MIRACLE Screen Printing! You save
them up to 50% on many jobs—yet you make up to
300% profit! When the word gets around people
come to you—no selling necessary! Because this
sensational printing discovery is so new, many
Screen Printers sell exclusively by mail!

WE SUPPLY EVERYTHING YOU NEED! Every secret,
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the way with our Personal Counseling Service &
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helped others, and how we can help you, too! All
the CONFIDENTIAL, money-making facts are
yours if you MAIL COUPON today—while there's
still time for you to get in on the ground floor!



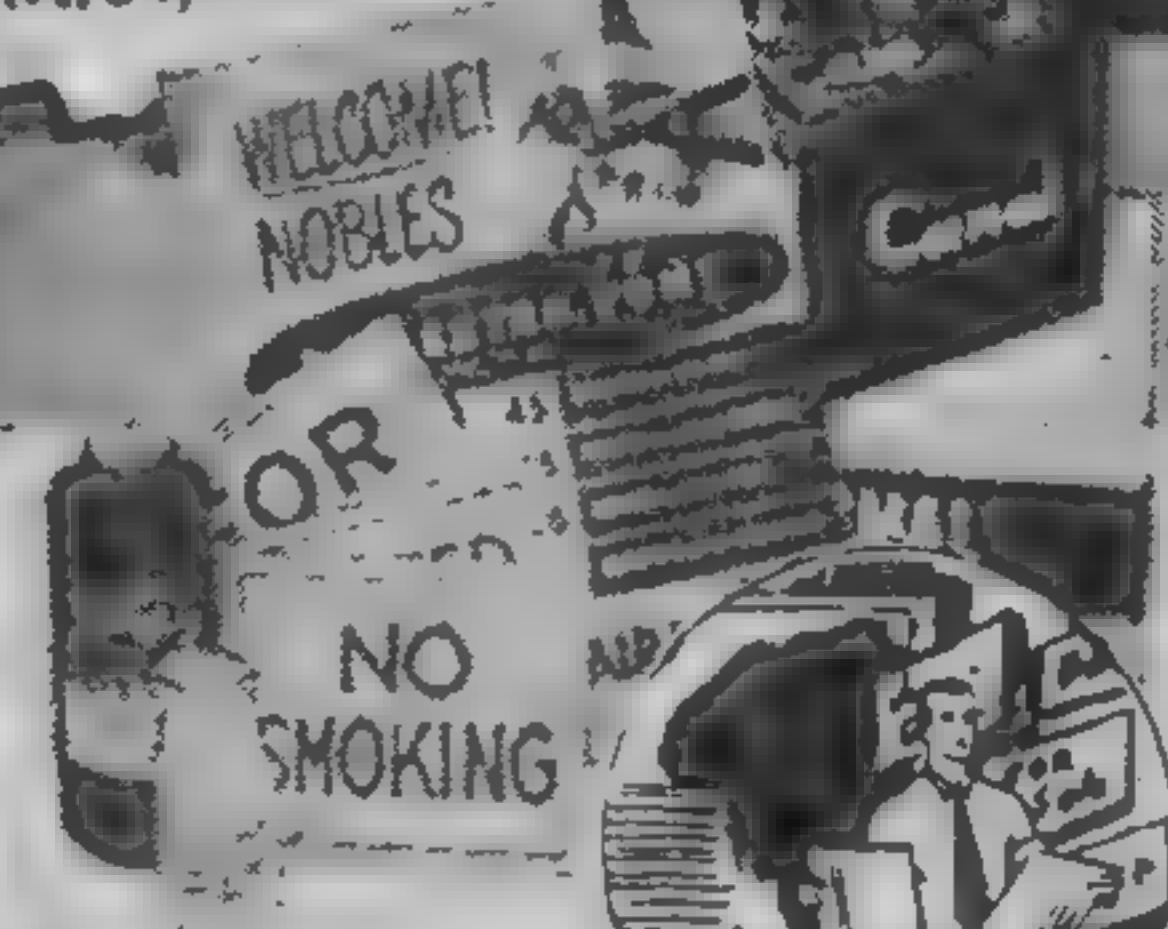
PRINT WITHOUT A PRINTING PRESS!

OR ANY SPECIAL EQUIPMENT



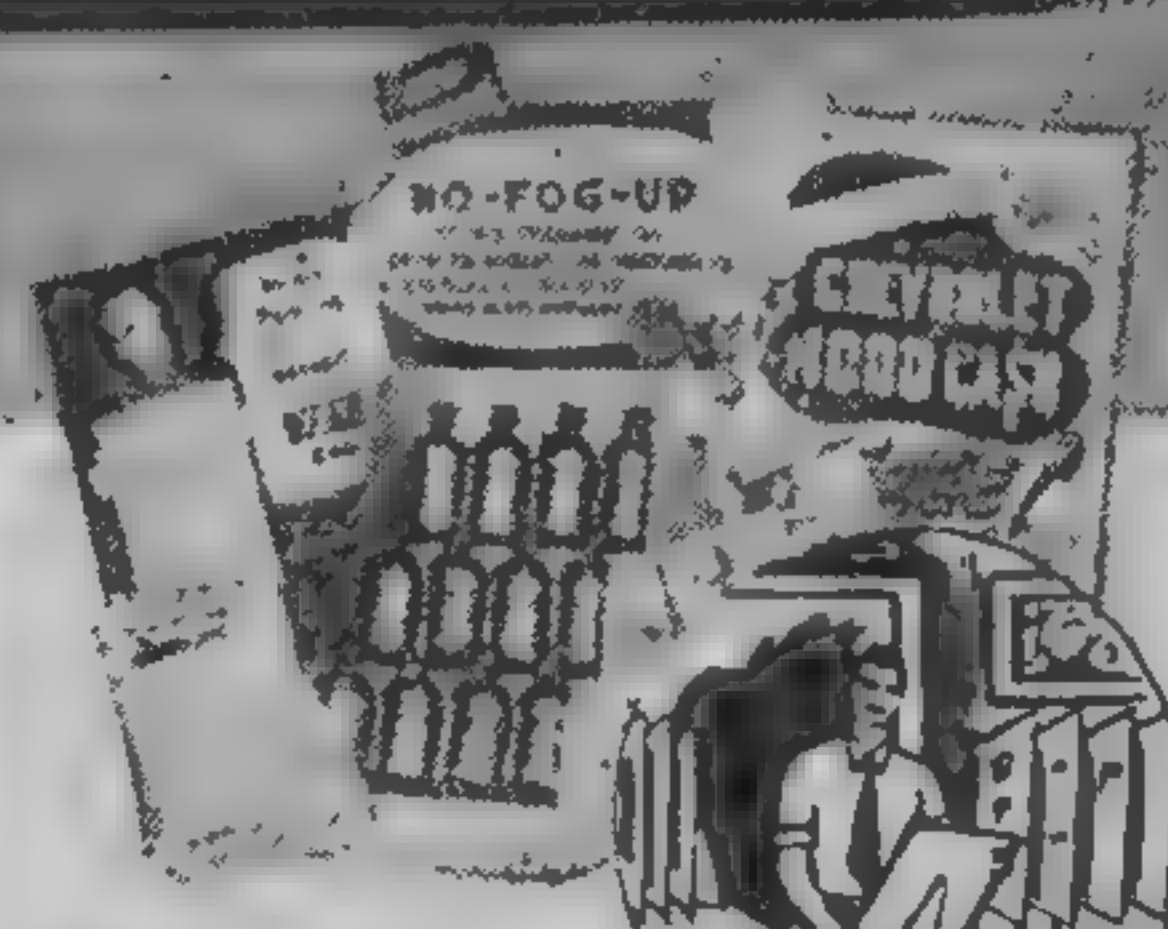
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For many years, I have been publisher of a famous magazine—**SPECIALTY SALESMAN**. It's for two kinds of good, solid folks: some like you, making out all right on a pay job, maybe, but wishing they knew some way to do a little better for themselves. And folks who used to be like you, but who today are making as much as \$300 a week, some even more! How? I'll tell you. My money-making secret is in your mind! One fact psychologists now know about you and me is, we let words scare us. Yes—words! If I said you could make extra money as a salesman—well, that does disturb you a little, doesn't it? Then you are letting a little word scare you—because I'm not trying to make a salesman out of you. I'm going to show you how to make extra money—maybe five, ten, twenty dollars a week to start—just showing attractive products to people.

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Don't smile! It works. All kinds of goods are bought on sight every day. Thousands of people, no different from you, are doing it right today with the help of **SPECIALTY SALESMAN**. They're not really selling yet, either. You have spare time that isn't paying you a penny right now; all you need is the right product and your spare time can pay you dollars. And my magazine, **SPECIALTY SALESMAN**, shows hundreds of buy-on-sight products every month. I want to send you the next 6 issues—FREE!

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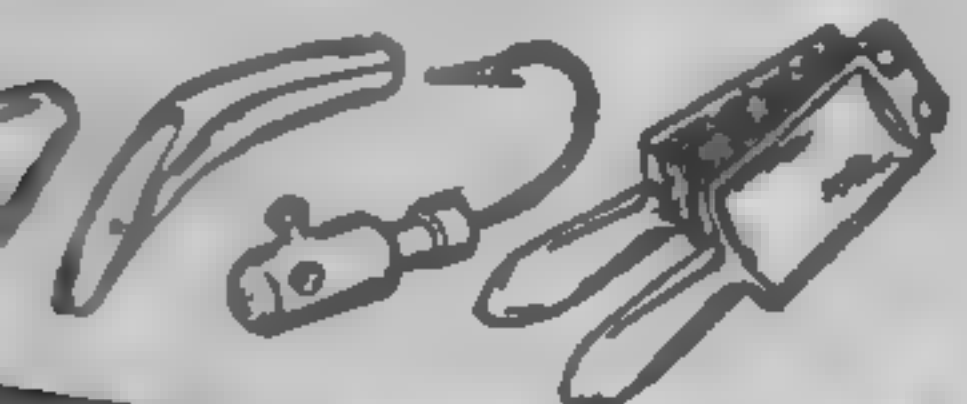
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Are You Ready for

Independence?



This Two Minute Quiz Could Alter Your Life

Here are ten questions which can be answered "Yes" or "No". Put an X in the square showing your answer. Then see, in the article below, what your answers indicate.

Yes	No		Yes	No	
<input type="checkbox"/>	<input type="checkbox"/>	Do you believe your present job is interesting and inspiring?	<input type="checkbox"/>	<input type="checkbox"/>	Have you ever wanted to own your own business—be your own boss?
<input type="checkbox"/>	<input type="checkbox"/>	Are you proud to tell others what kind of work you now do?	<input type="checkbox"/>	<input type="checkbox"/>	Have you felt that starting a business might jeopardize your job?
<input type="checkbox"/>	<input type="checkbox"/>	Do you see promotion ahead of you to an executive position?	<input type="checkbox"/>	<input type="checkbox"/>	Do you ever wish you could take time off without being "docked"?
<input type="checkbox"/>	<input type="checkbox"/>	Are you satisfied with your present pay or wage? Your standing?	<input type="checkbox"/>	<input type="checkbox"/>	Would you like to be able to keep all the profits from your work?
<input type="checkbox"/>	<input type="checkbox"/>	Do you make enough to give your family the luxuries of life?	<input type="checkbox"/>	<input type="checkbox"/>	Would you like to be the architect of your own independent future?

What do your answers indicate? Are you ready to start planning for a life of personal independence? Are you sufficiently dissatisfied with your present lot in life to give serious consideration to a plan that may lead to a brighter future? Are you interested enough to spend four minutes reading?

By John R. Miller



A great philosopher once said, "Dissatisfaction with oneself is the divine spark that kindles the fires of accomplishment." And isn't "dissatisfaction" just the negative way of describing a deep yearning for something better? If your answer to the first five questions was "yes" read no further—you are satisfied and you must have an exceptional job. But, if you have a spiritual yearning to be a "somebody" in a business of your own, you'll be fascinated by this entirely new way to make your start toward personal independence.

What keeps so many men in humdrum, blind alley jobs? The men who make a study of this problem say three things: 1) Fear of losing the partial security they have in the weekly paycheck; 2) fear that the project they start may fail, and 3) not knowing what kind of business to enter, how to start, and not having any one who can guide them to success.

You'll be thrilled to know that right now—out of an old and respected profession—a new kind of business has been born. It's a business that can be learned by anyone who can hammer a nail or tighten a nut on a bolt. Starting this business only requires that you enjoy working with your hands—that, and a small amount of money to invest in yourself.

It is a business that any adult can start in spare time, in one corner of a bedroom, basement, or garage. You can continue to run it in spare time. It can make extra

money for those who want to keep their jobs. Or, it can be worked up into a full time business when you're ready to quit the job. It is so flexible that it's ideal for older men who want to add to their retirement pay without having to work any special hours.

Not a hamburger stand—not a rug cleaning business—not a house-to-house selling plan. Not anything you'd ever think of. It's a small machine, operated by any 110 volt current. The machine turns out a simple product that is in constant demand. From five to fifty of these products are used by every adult in the country. They are bought over and over again. Each and every year at least forty million new ones have to be purchased.

Yet the strange factor that makes this a rare opportunity for individuals is the fact that the business can never be taken over by a big corporation. It is a local business—one that must be operated by an individual—and a business that goes on year after year, good times or bad, constantly growing larger and more important.

It's a business that even works for you while you are on your regular job. If there's someone at home during the day, customers will be bringing jobs to your door and leaving them. Some might even bother you as late as ten at night. But the beauty of it is that each job takes only a couple of minutes. While you're waiting for dinner to be put on the table you can turn out three or four orders. Any five or ten min-

utes of spare time can be turned into a profit of three to four times the cost of your raw material.

I haven't revealed the name of this product and I don't intend to, here on this page. The revelation will come to you from Mr. Michael Roberts. It is his idea, his business, and his guidance that can help you to a start toward independence. So, I'll let him tell you about it.

Learning all the details will cost you nothing—not one penny. Through special arrangements Mr. Roberts has made you can have the whole plan for ten days without any obligation whatever. You can investigate its possibilities in your community. You can talk it over with your family or your business advisers. And, in doing so, you do not obligate yourself to buy anything at all. All Mr. Roberts asks is your promise to read the material he sends you and give his plan the thought that any intelligent man would give to a subject that might change his entire life.

After you know every detail of the plan, you make your decision. If it is "Yes", you can then arrange to make the small investment that will give you your start.

No, there is no risk in this—except the cost of a postage stamp. Even a government postcard will do. Just send your name and address to Mr. Michael Roberts, 1512 Jarvis Avenue, Dept. K-5-B, Chicago 26, Illinois. But do it at once. Don't delay your start toward independence by even a day.

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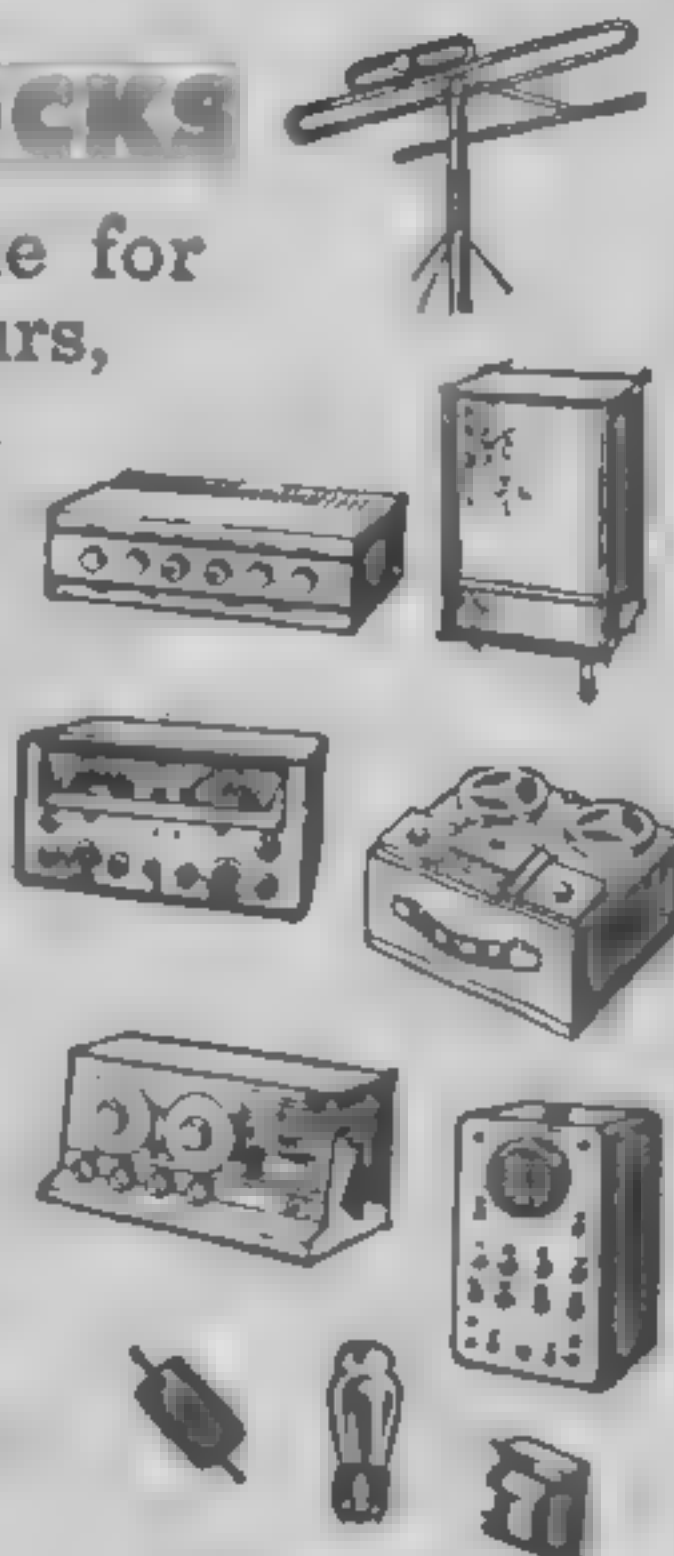
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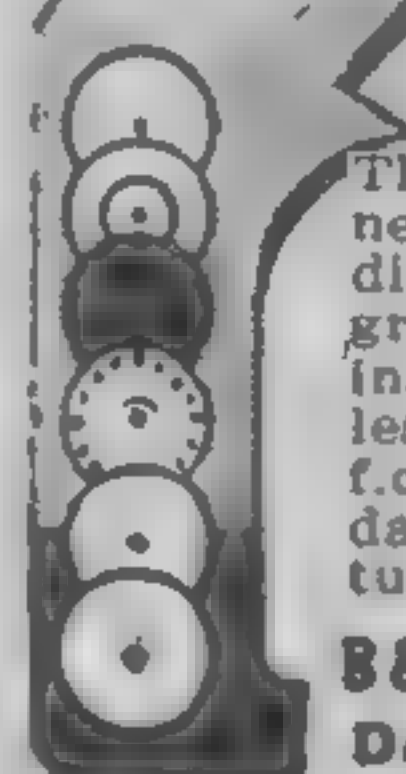
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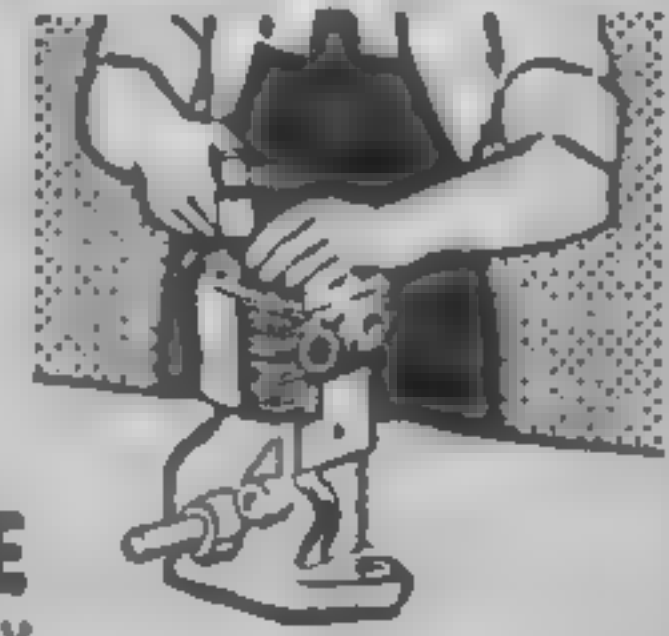


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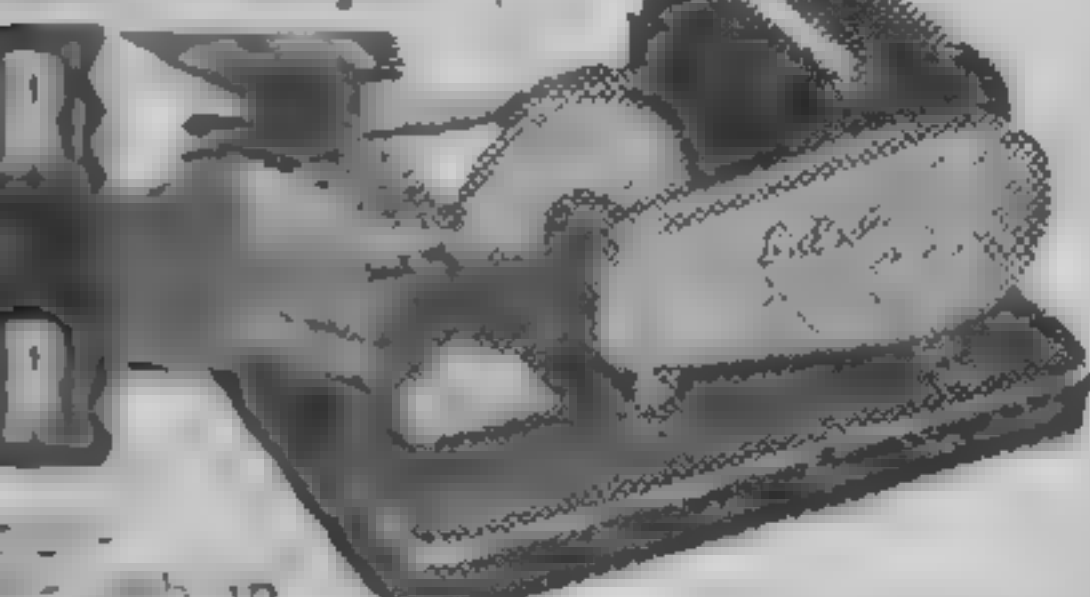
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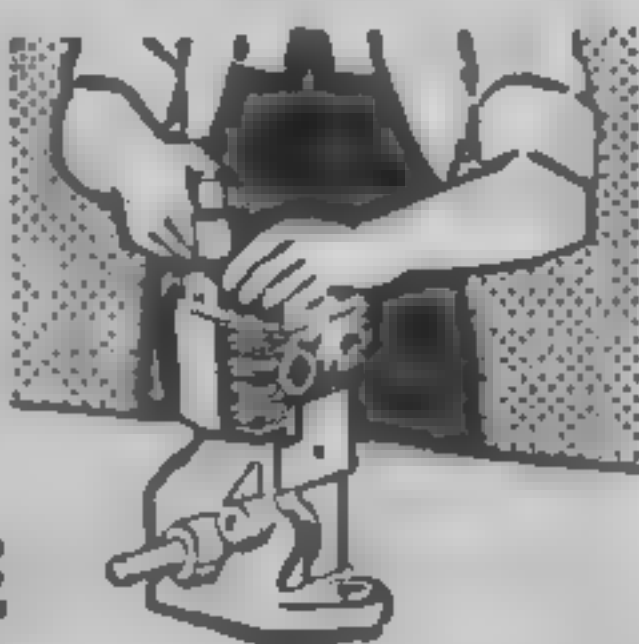
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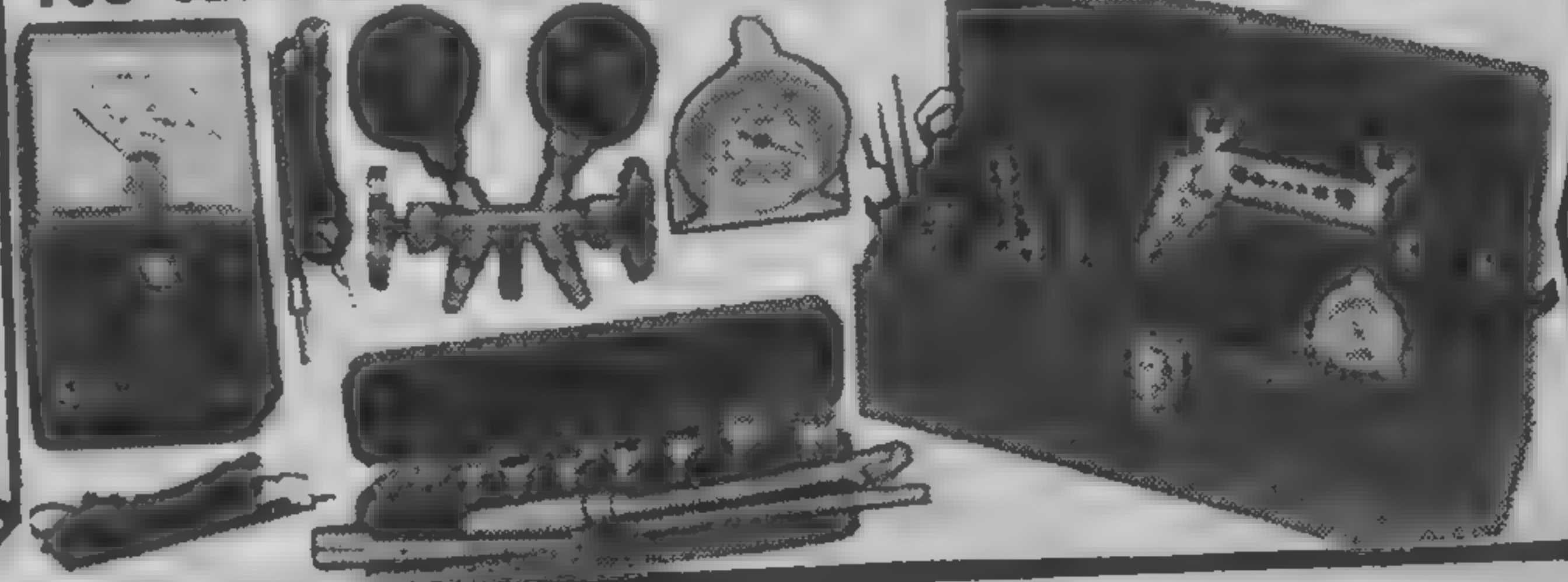
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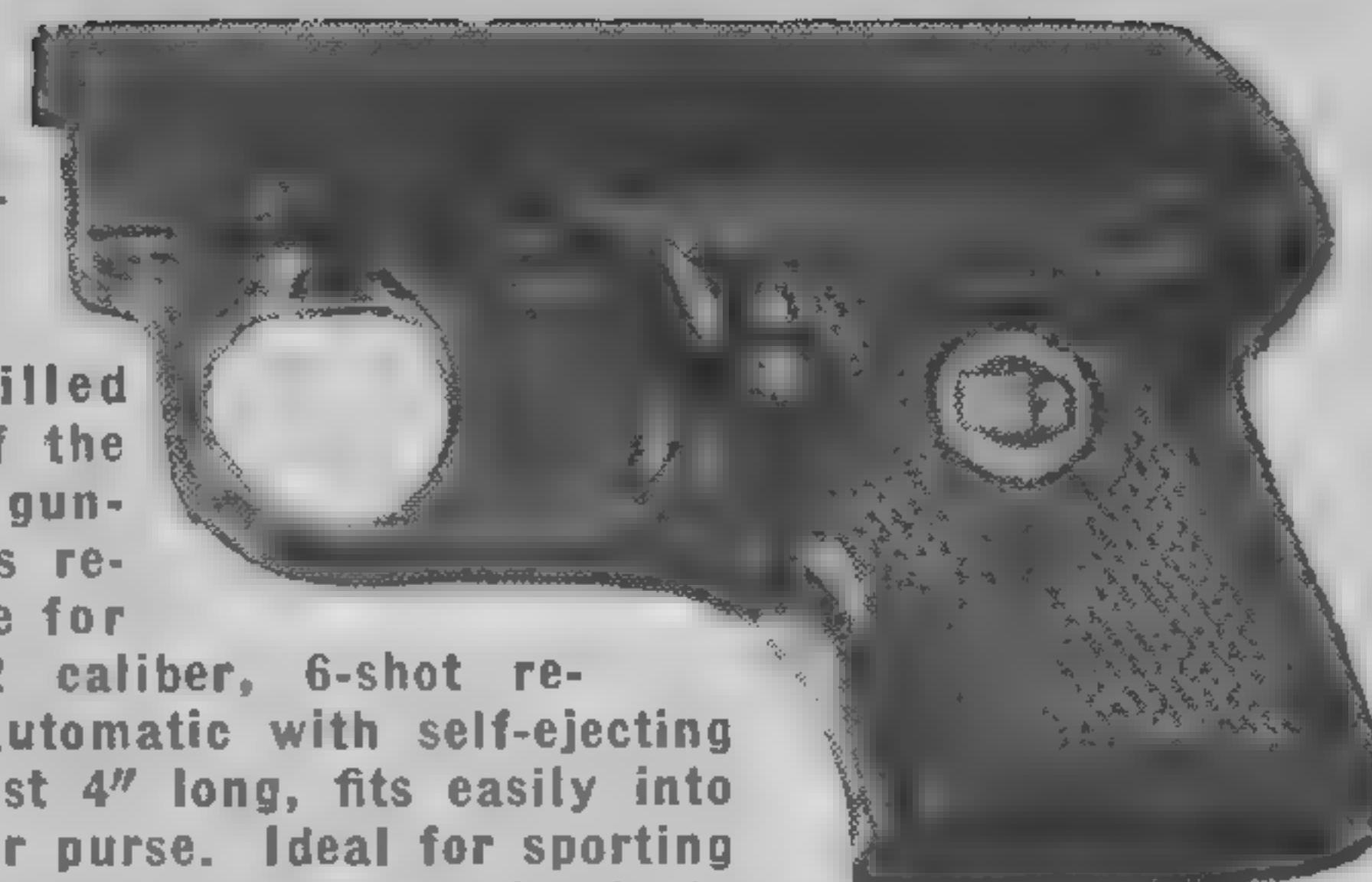
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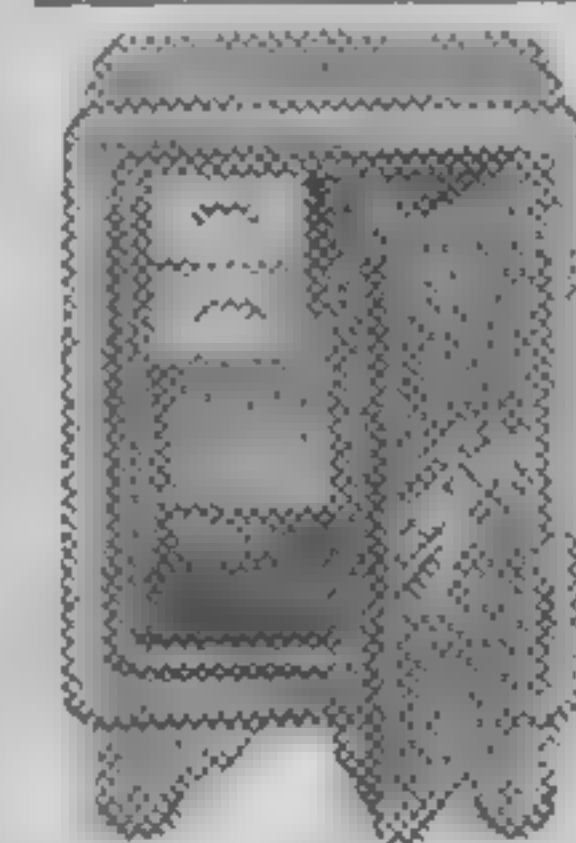
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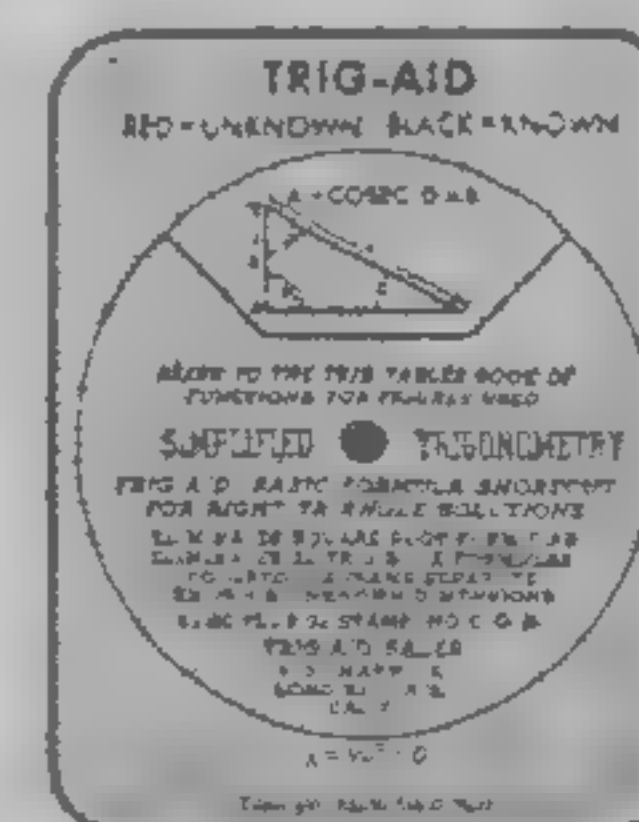
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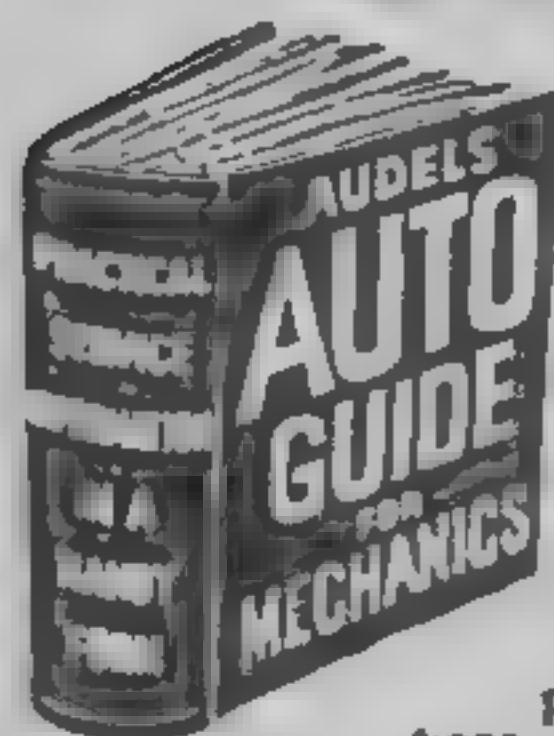


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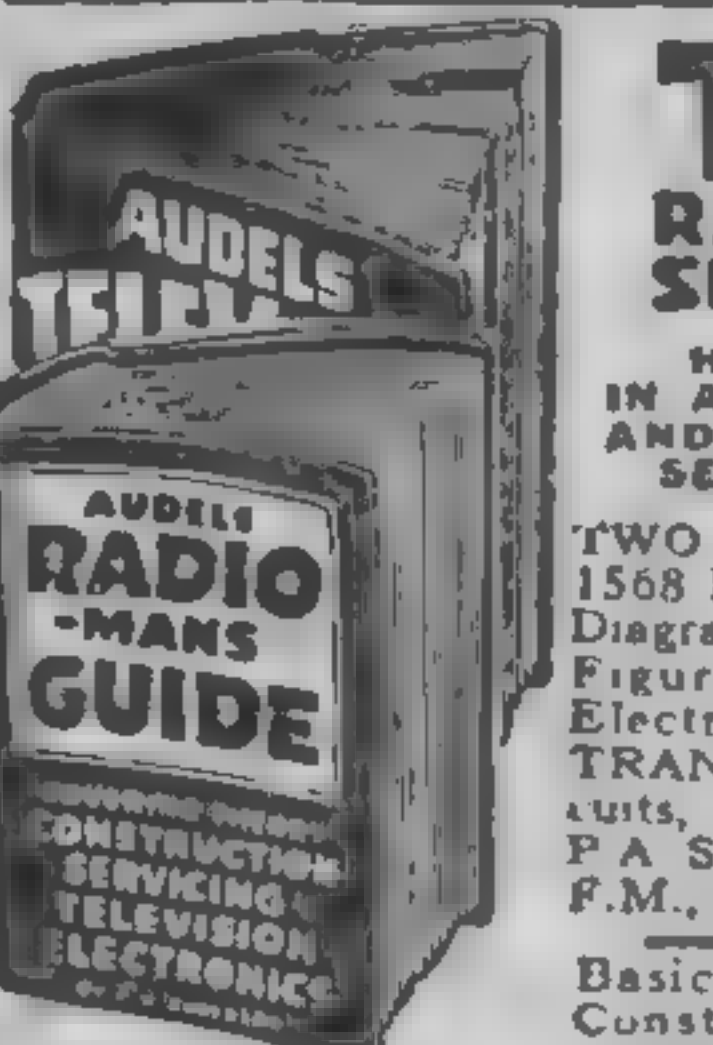
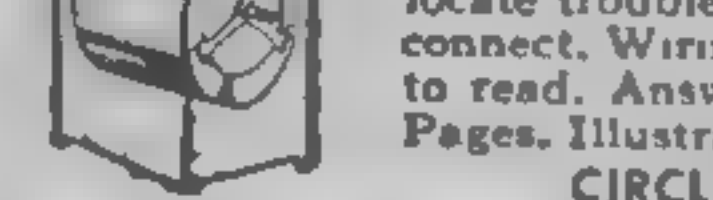
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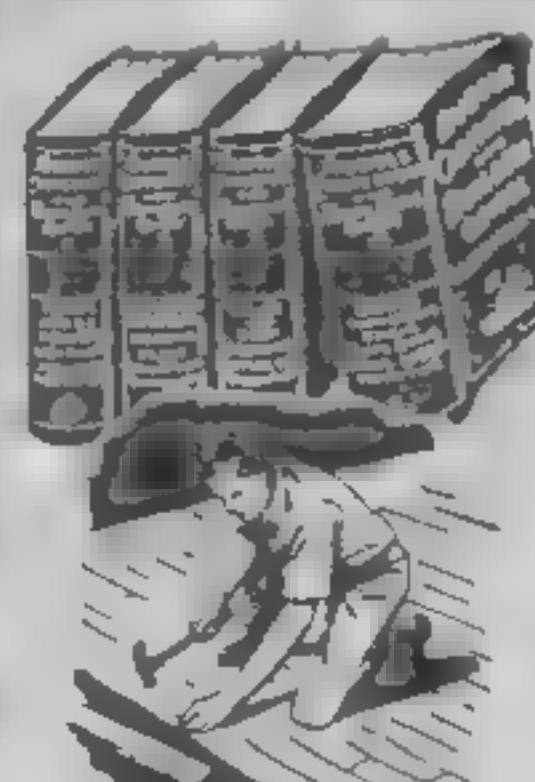
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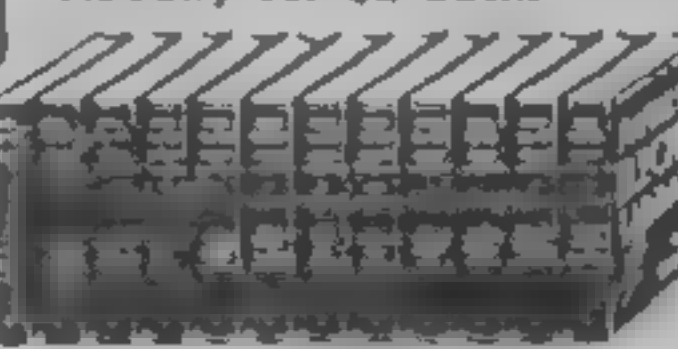
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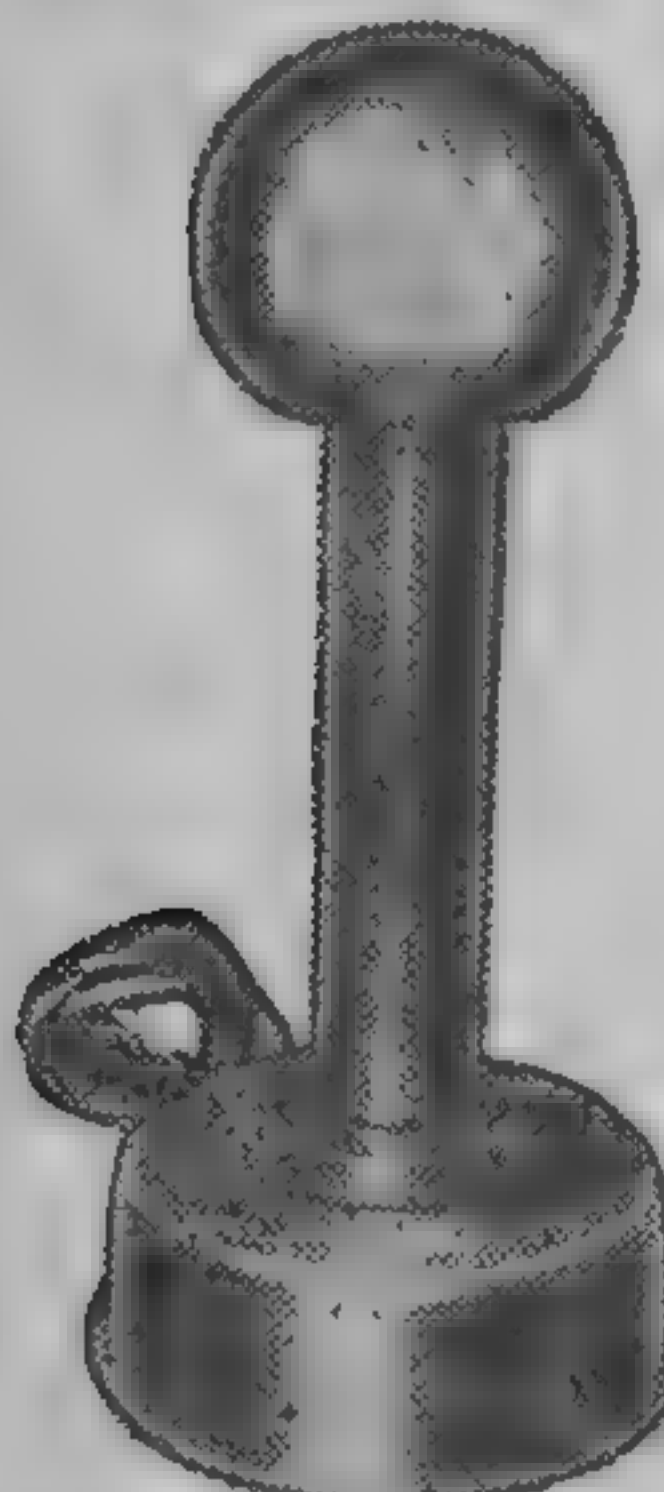
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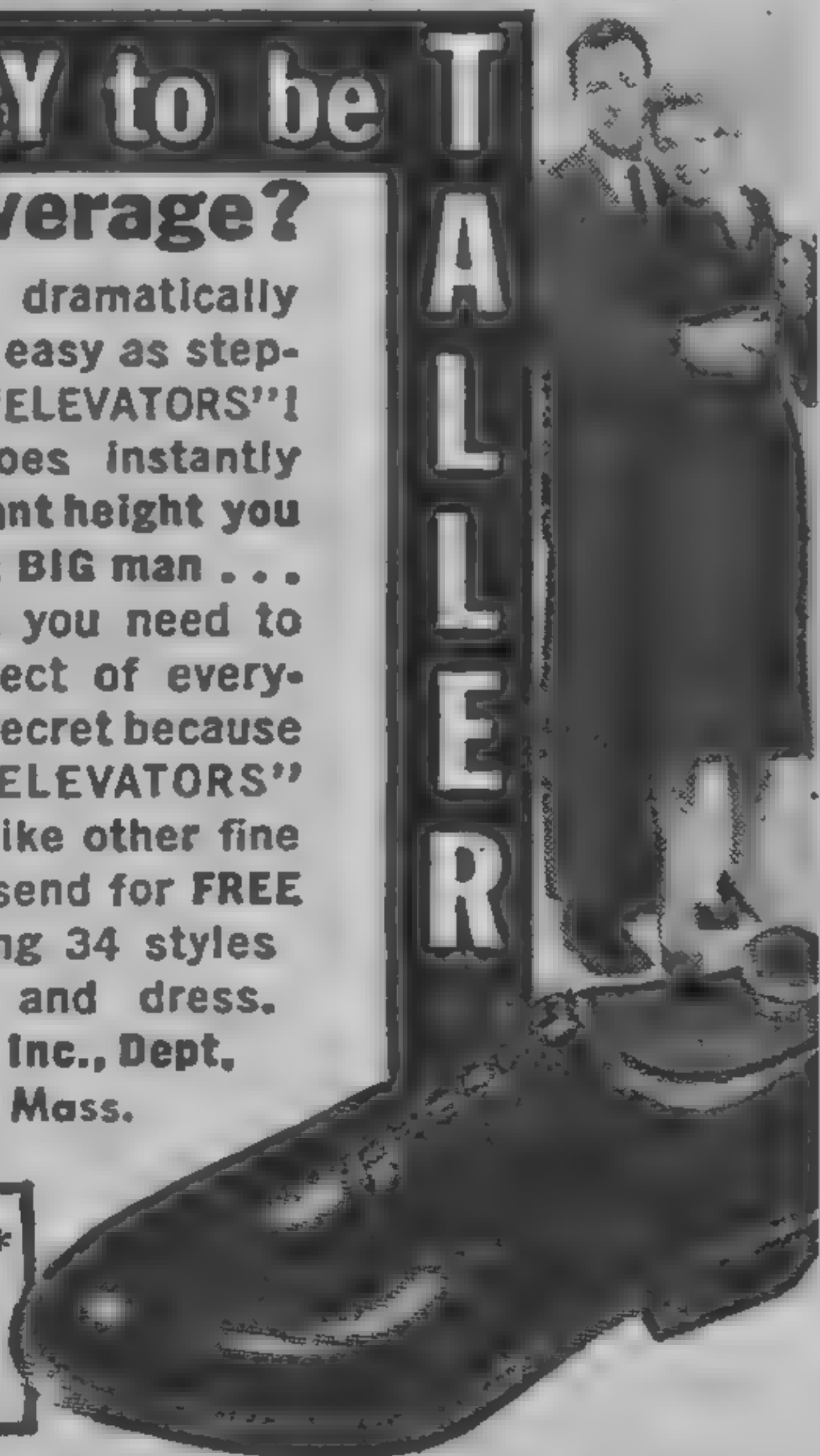
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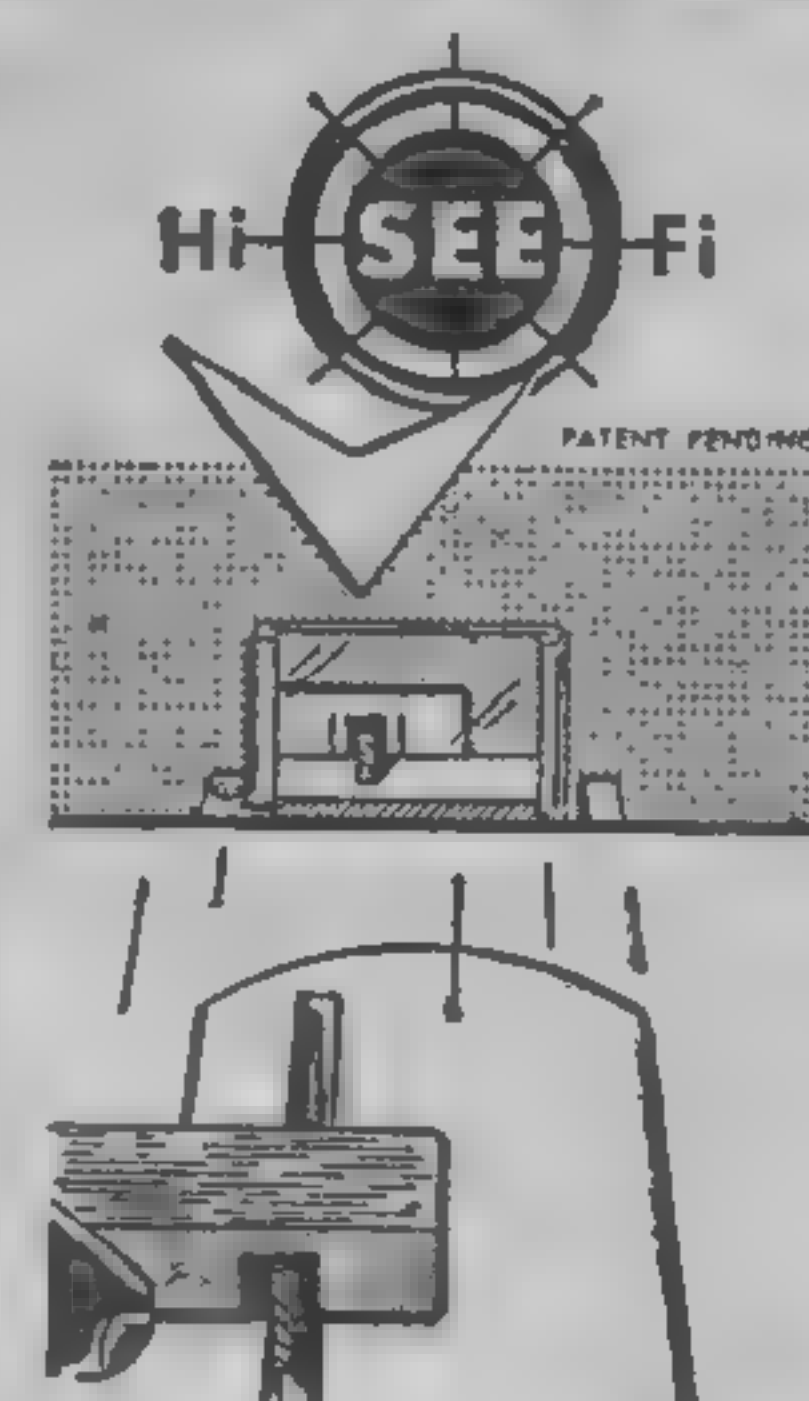
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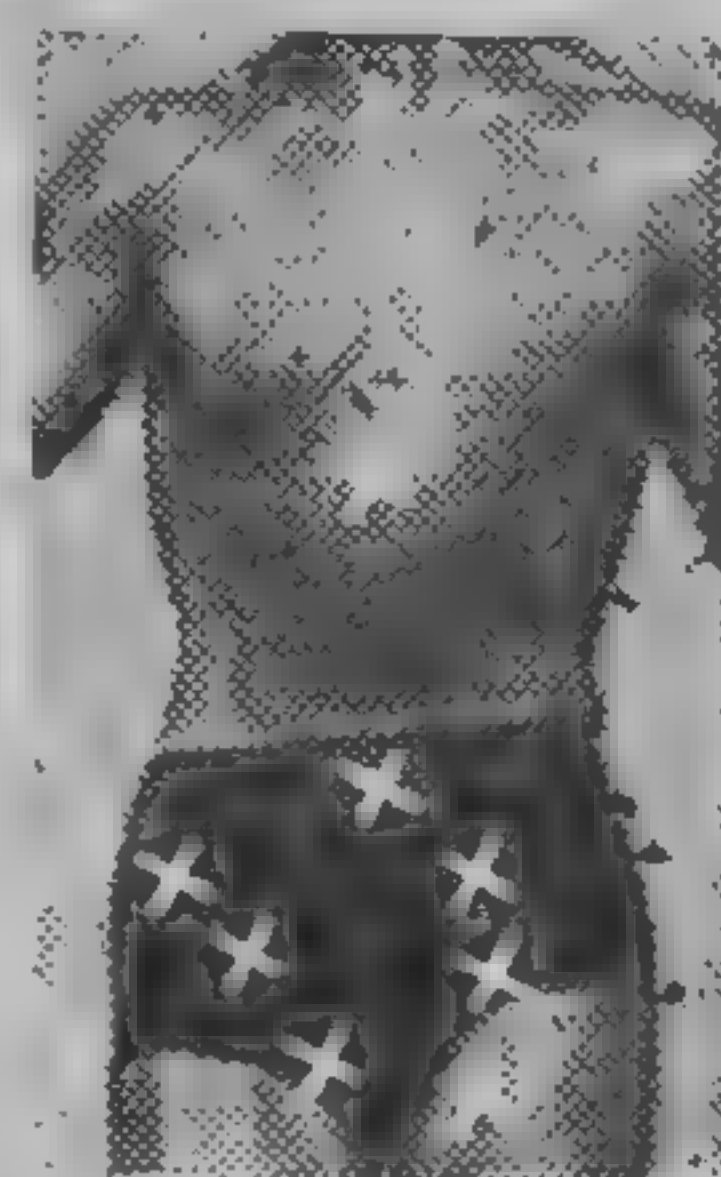
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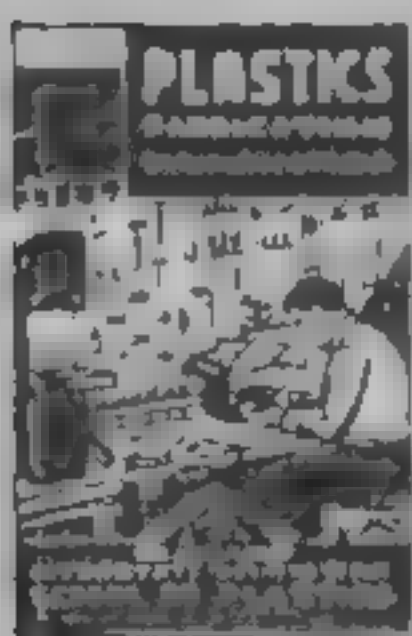
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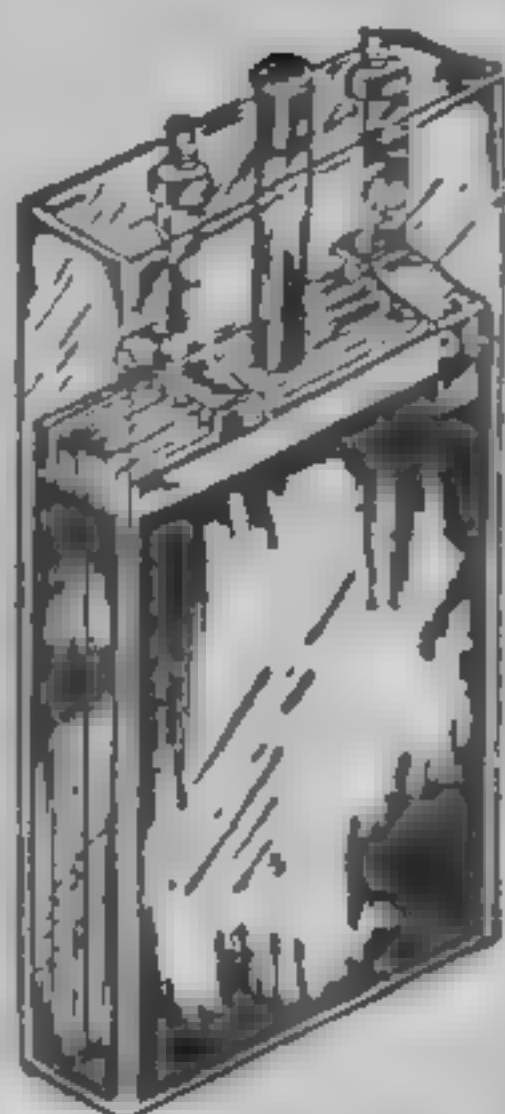
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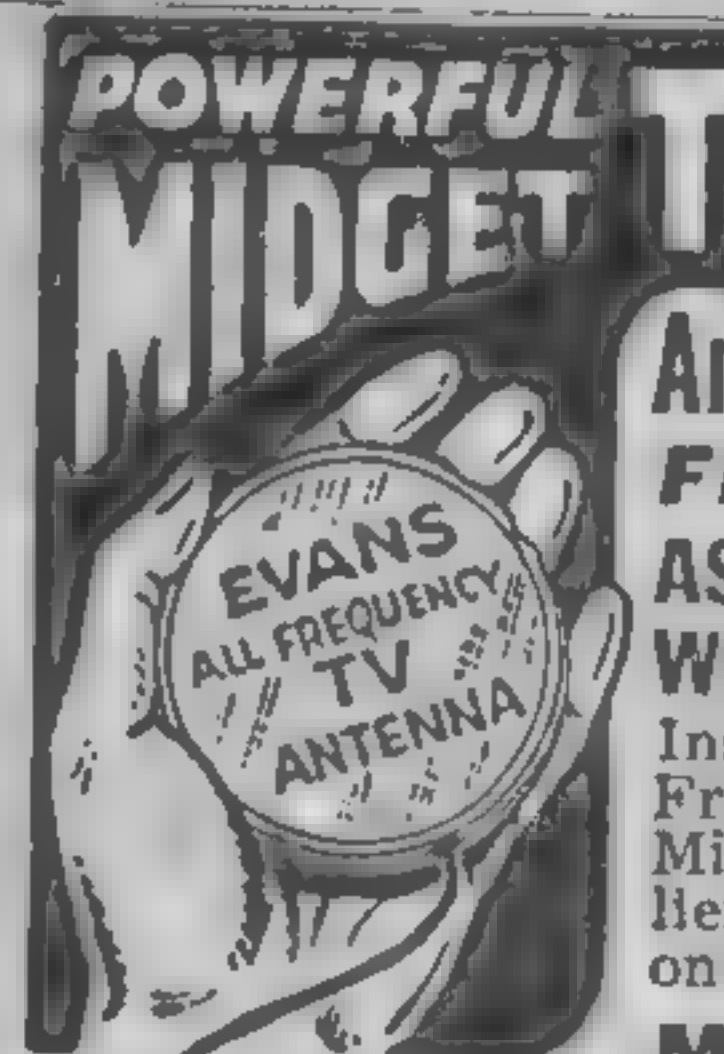
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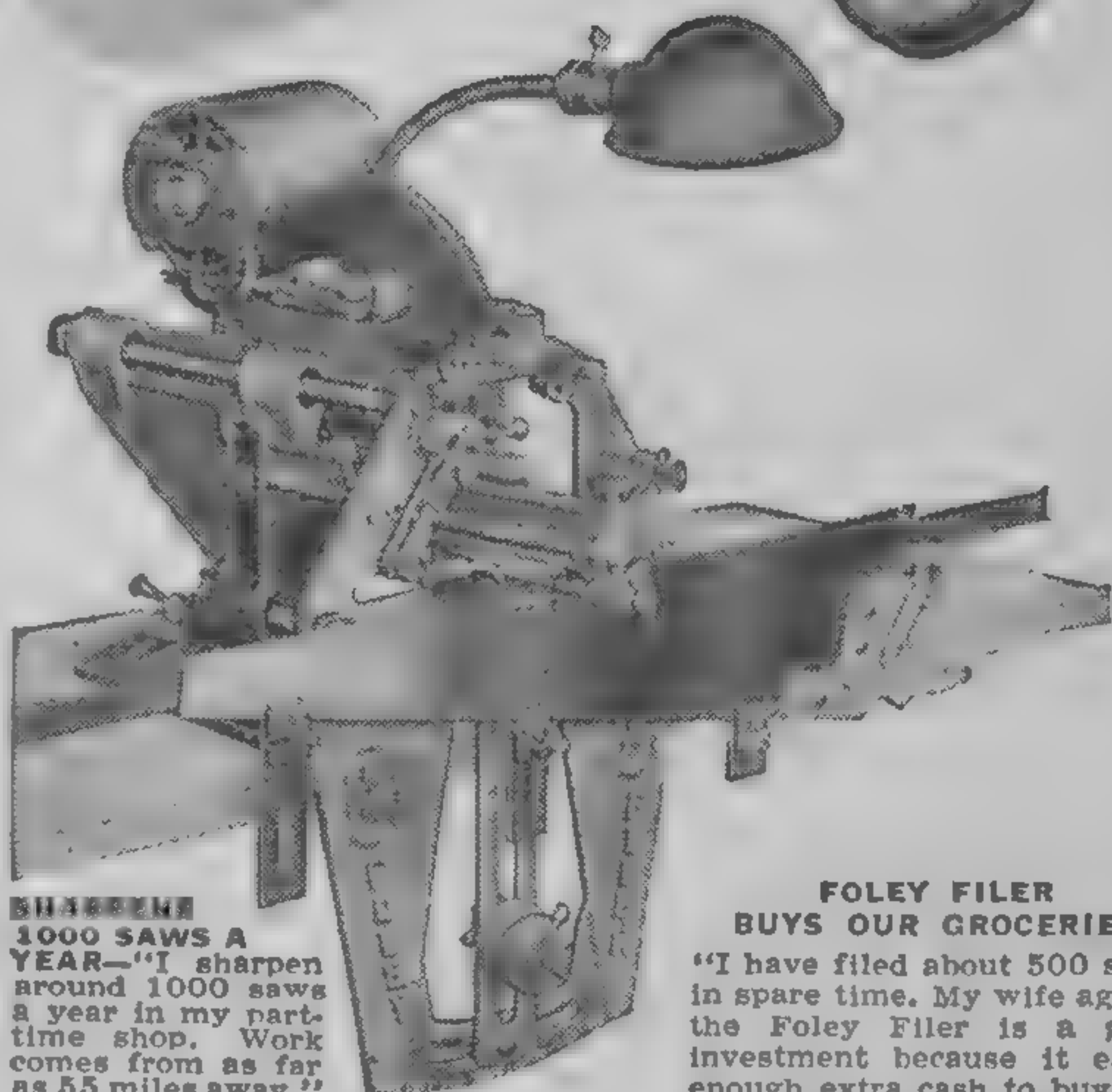
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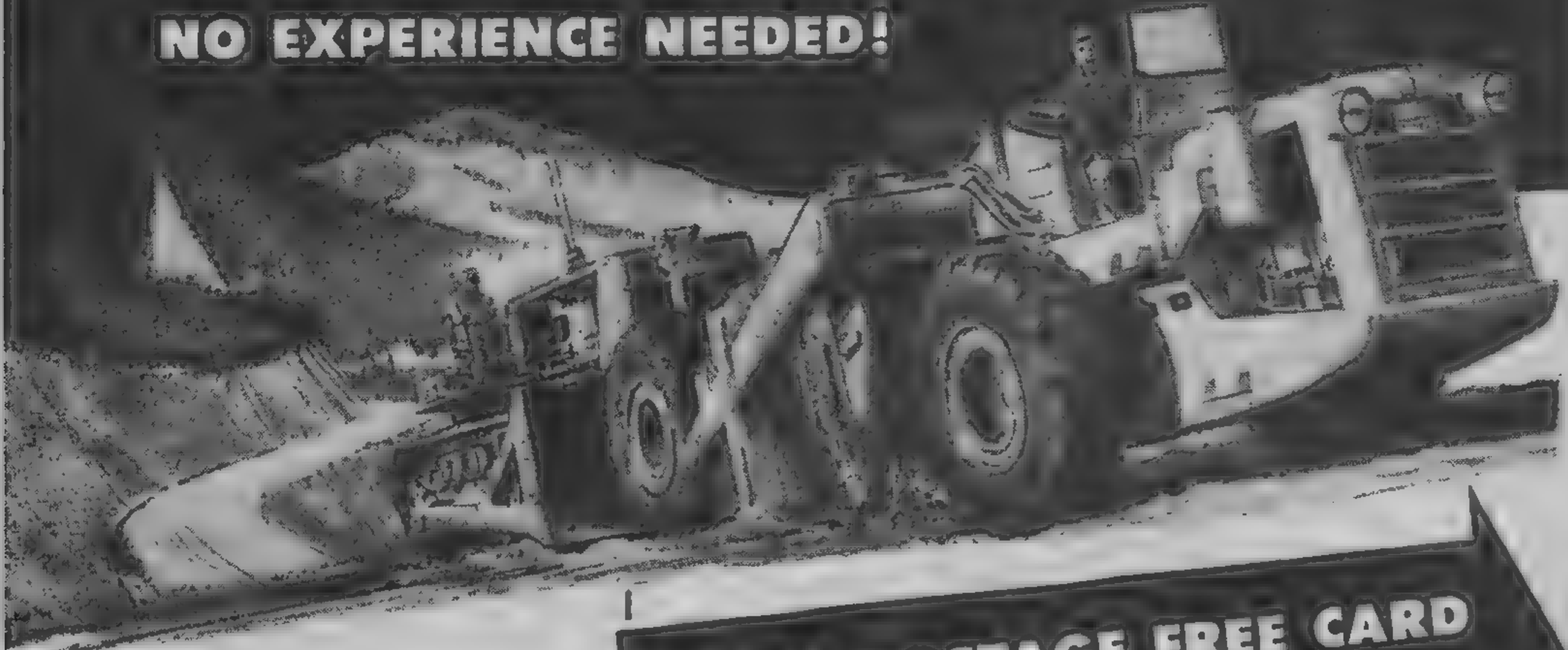
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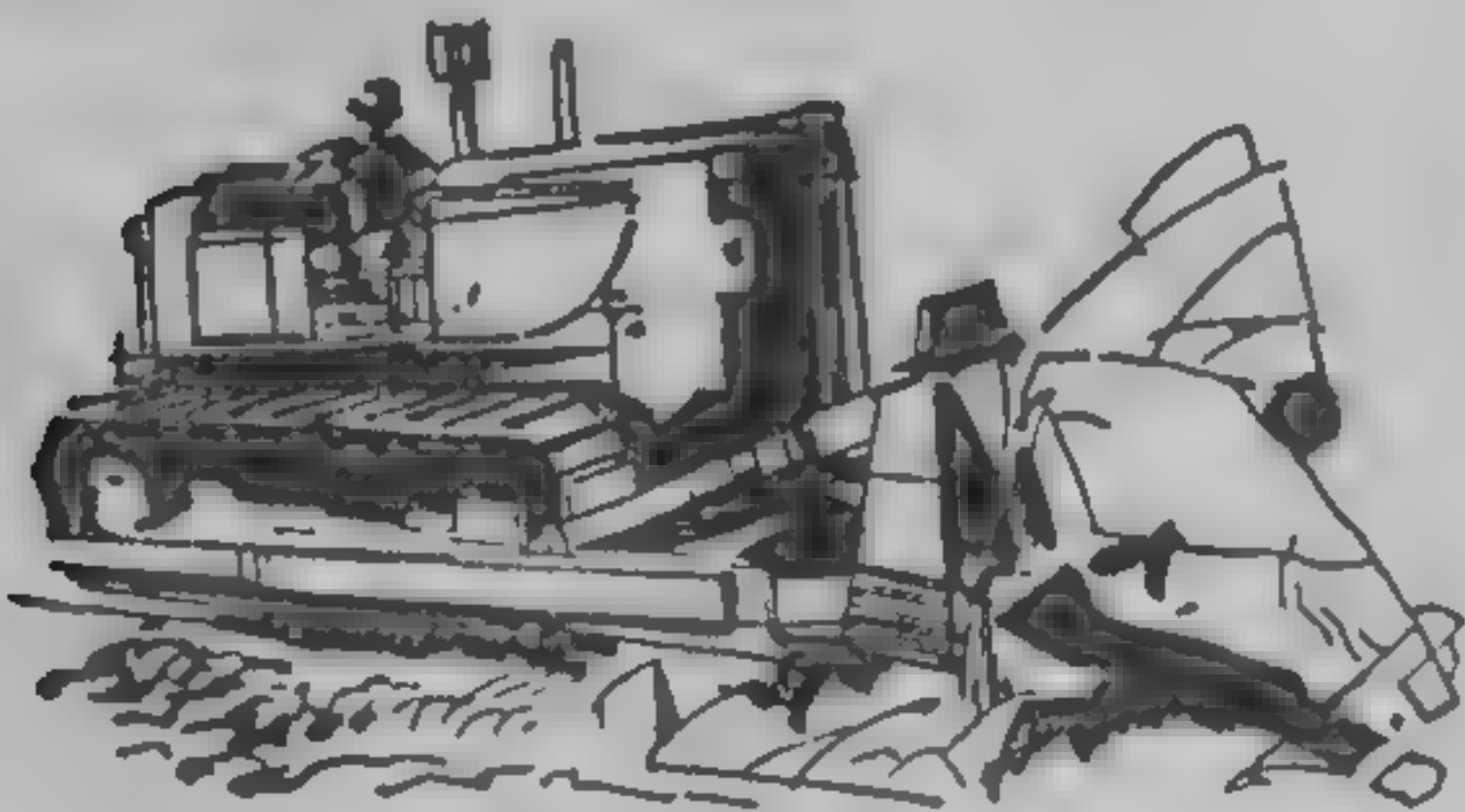
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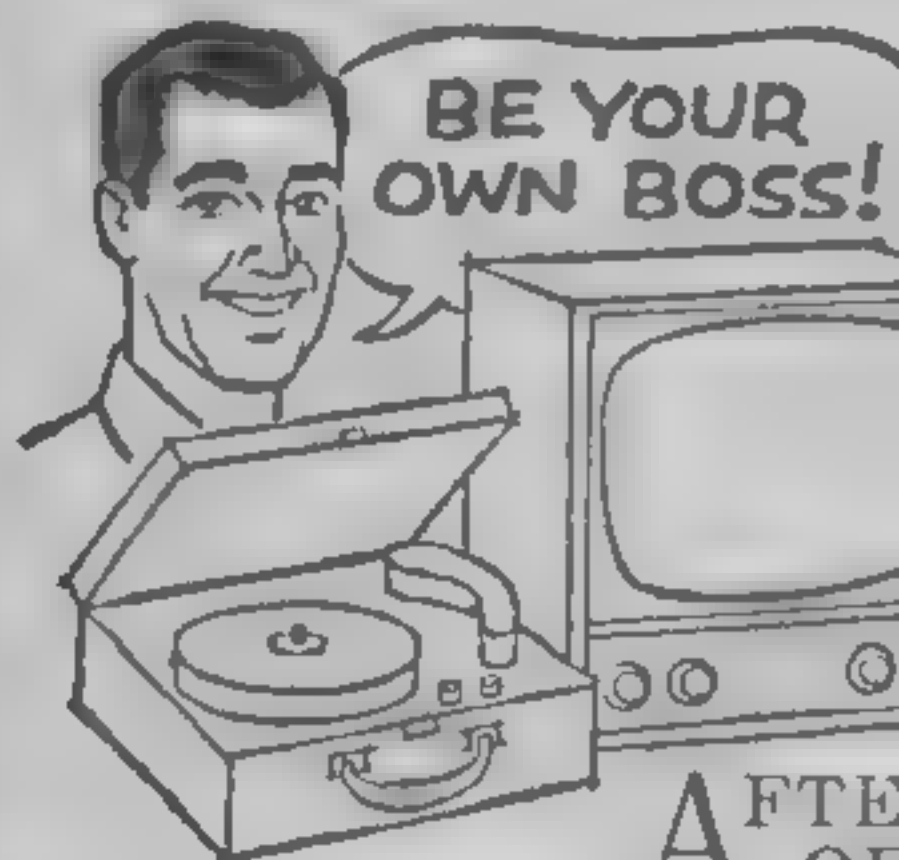
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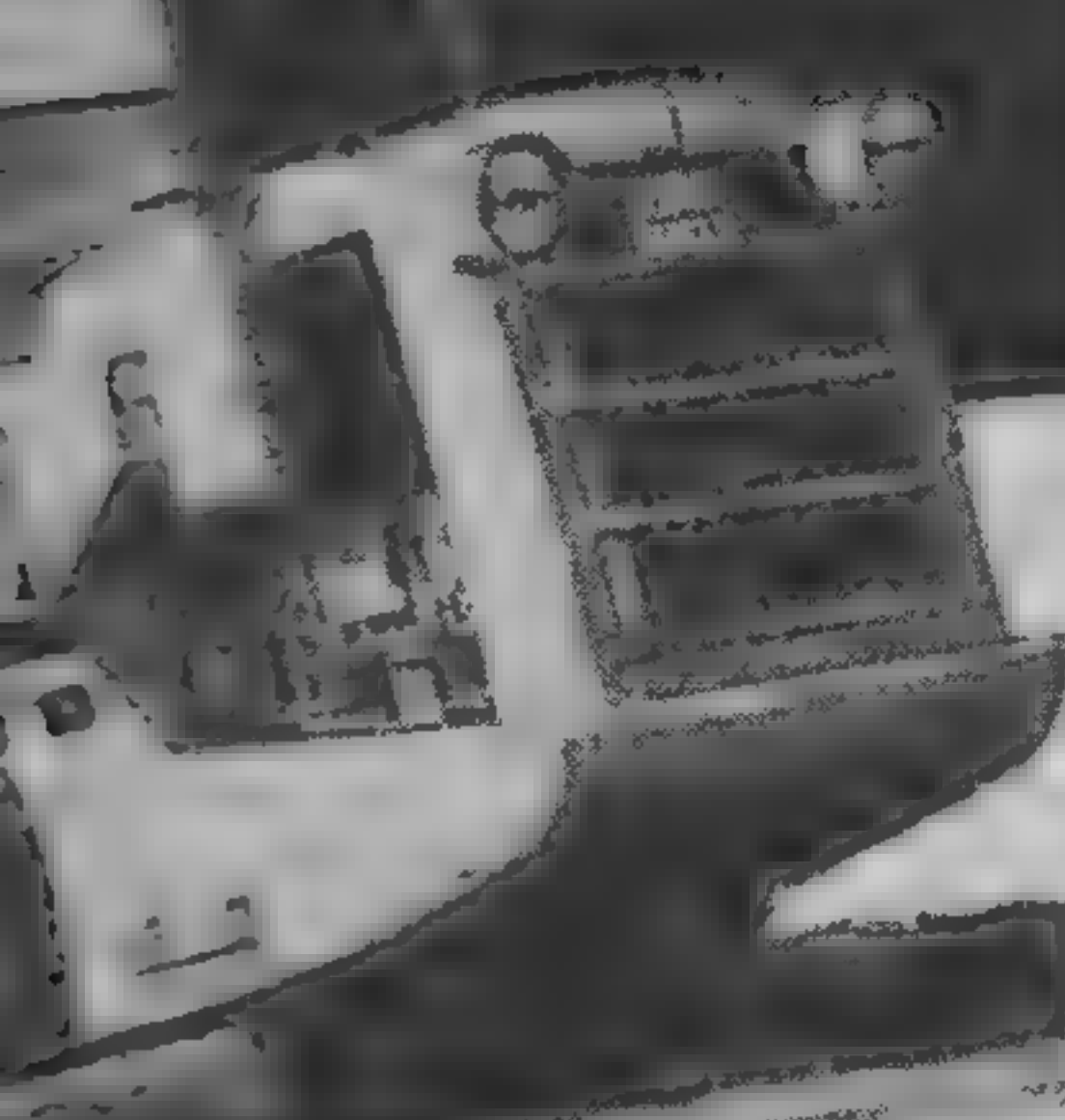
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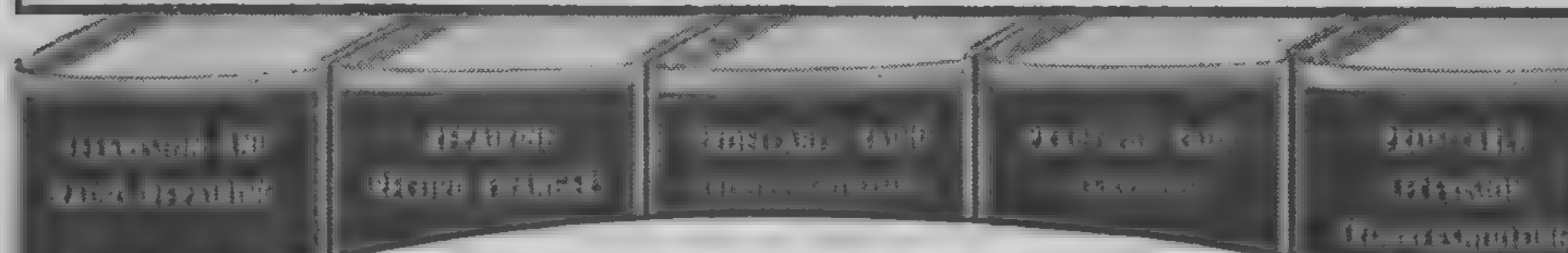
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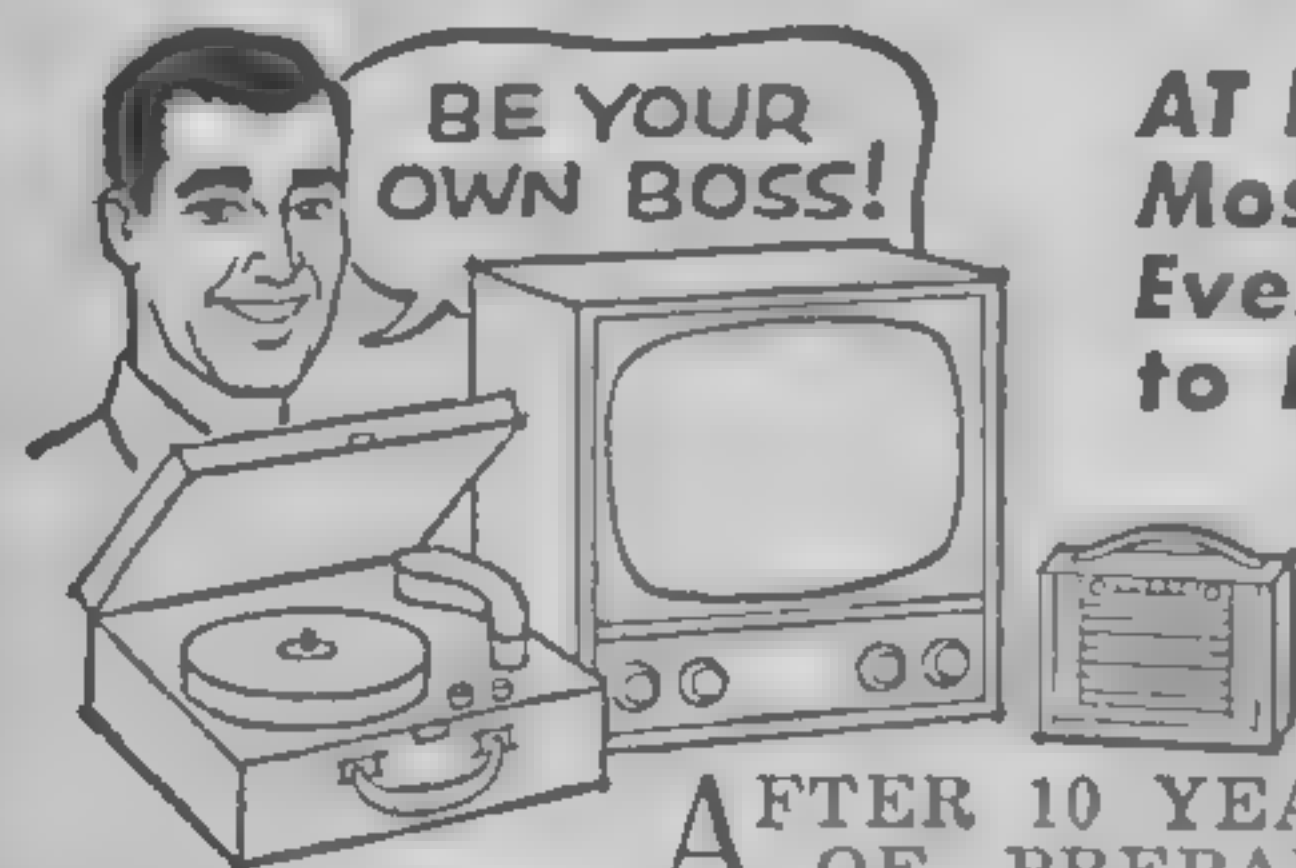
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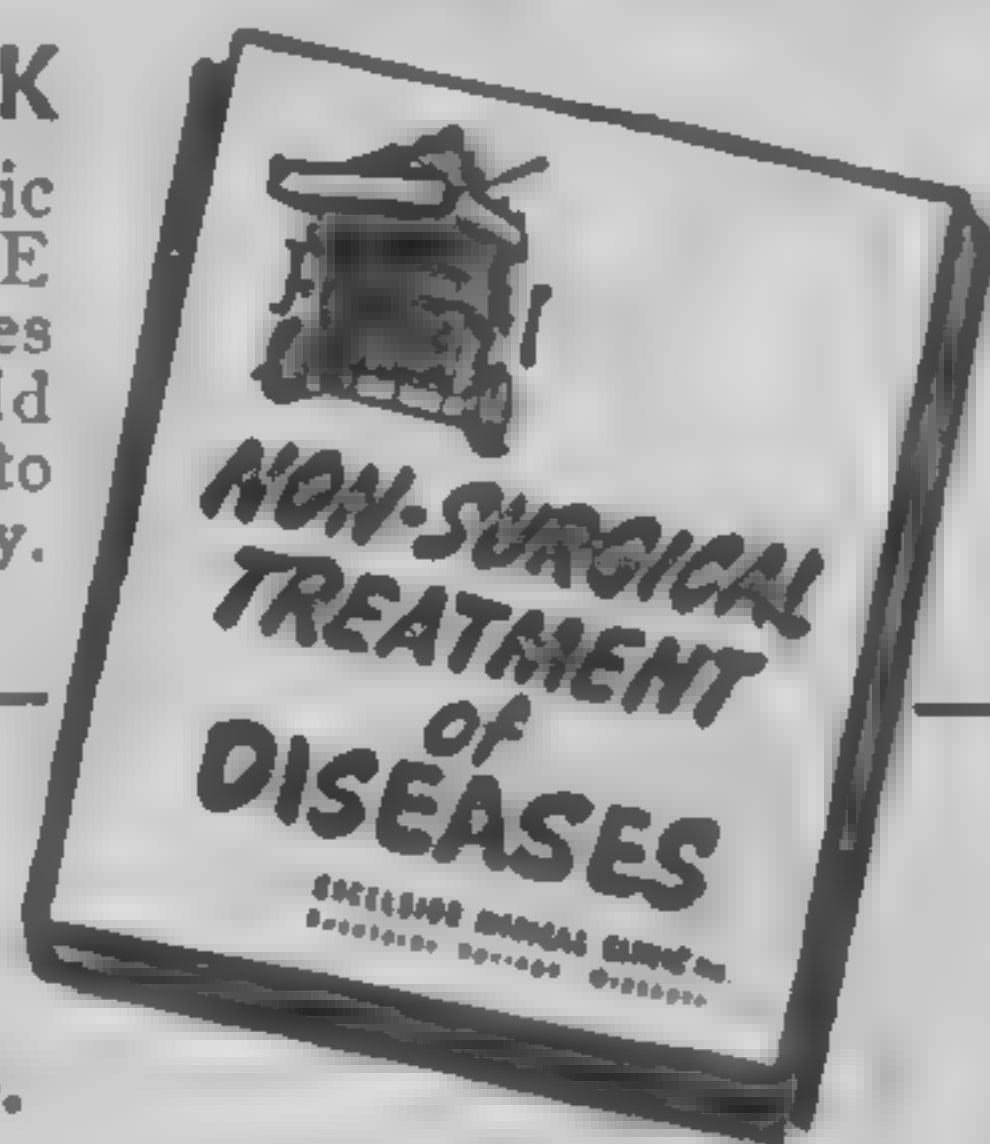
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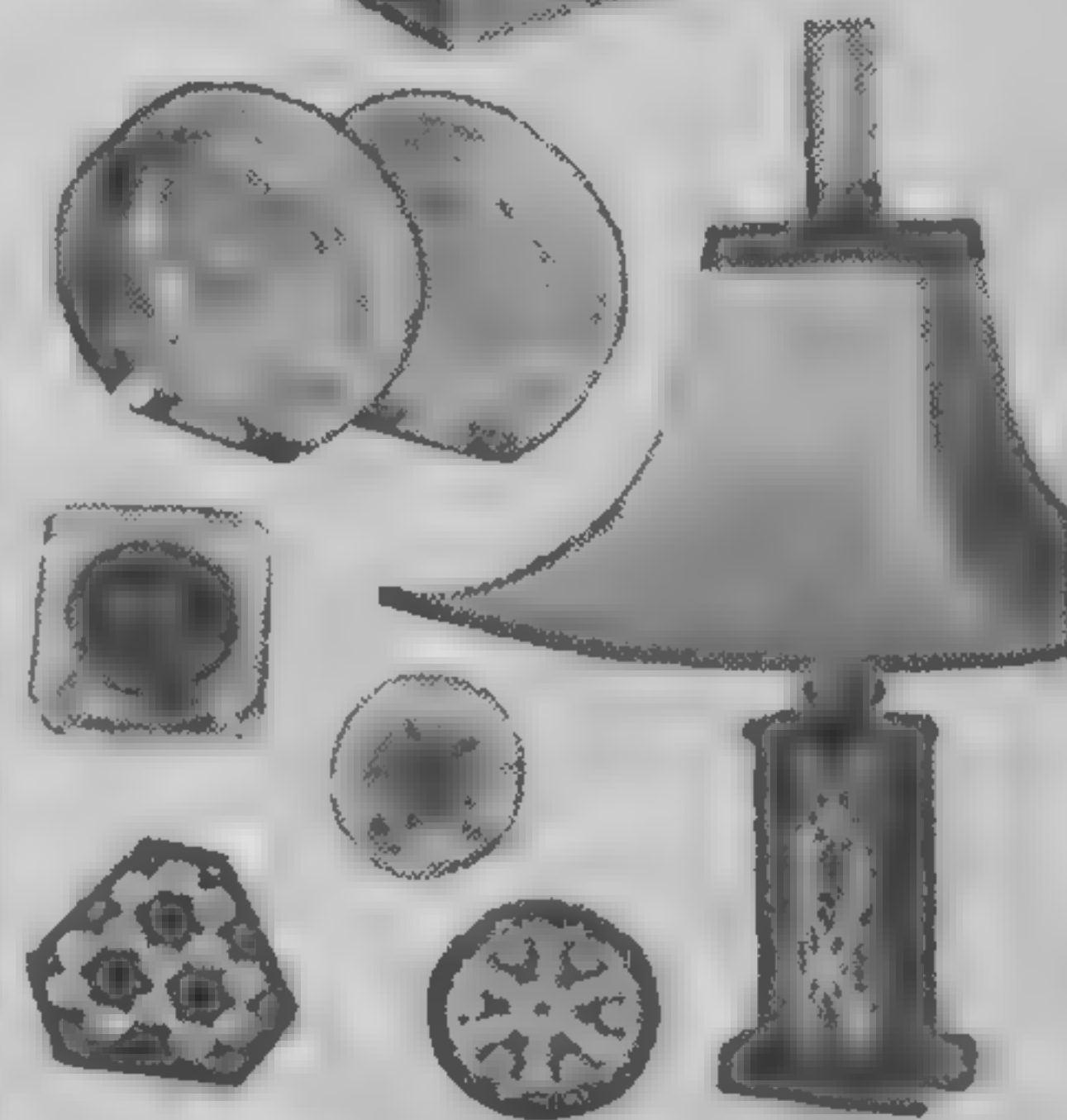
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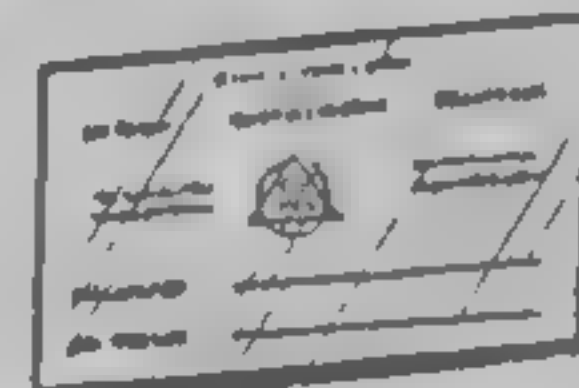
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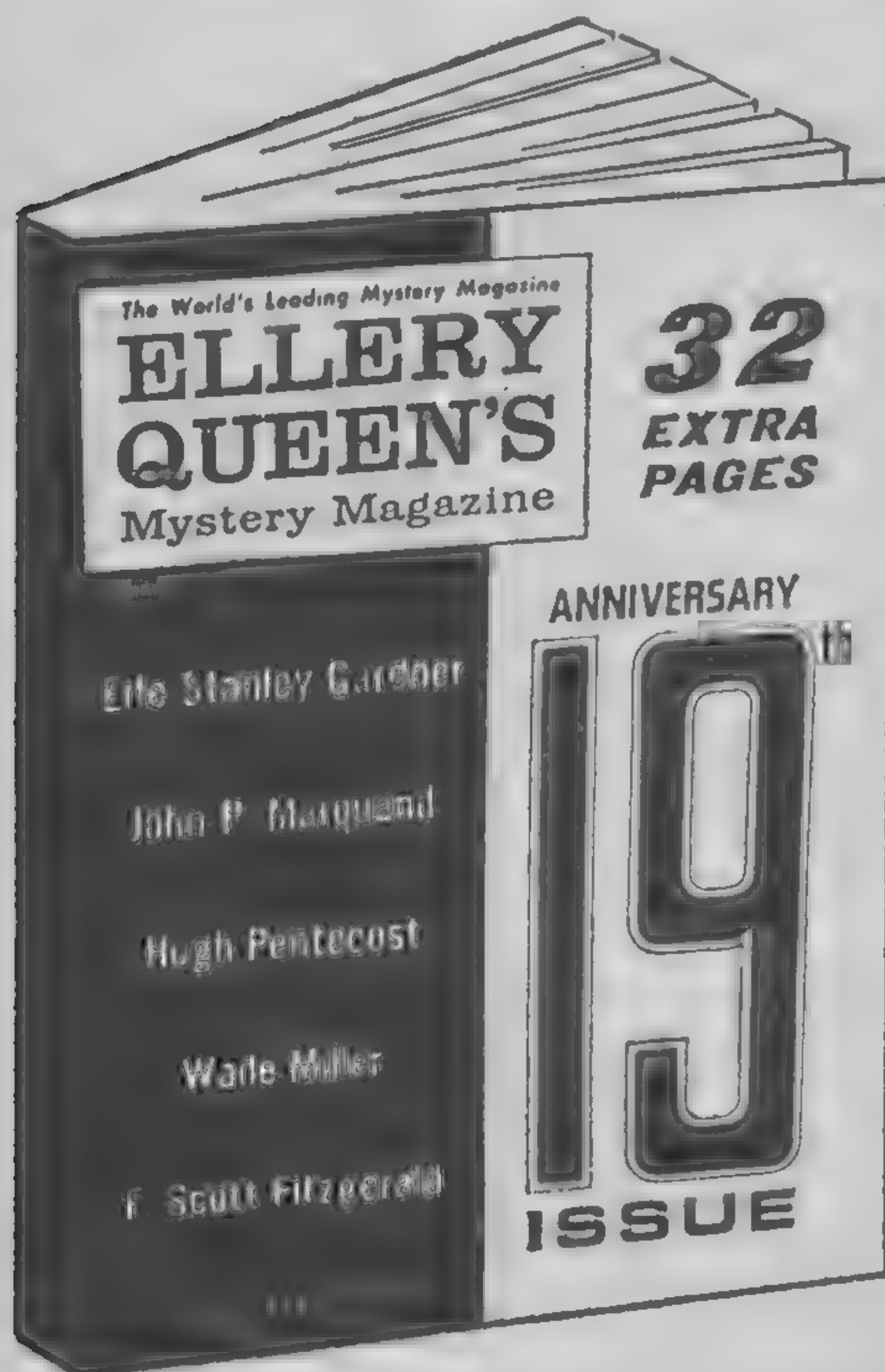
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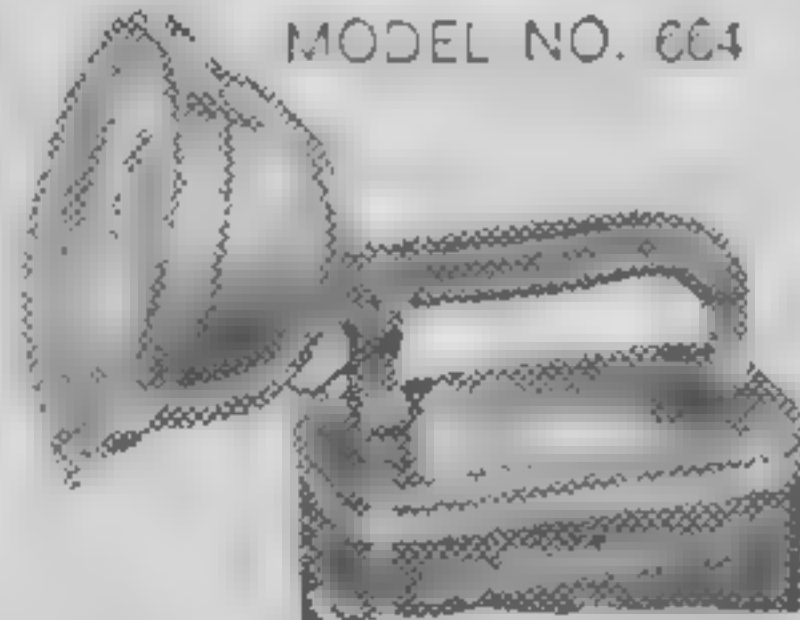
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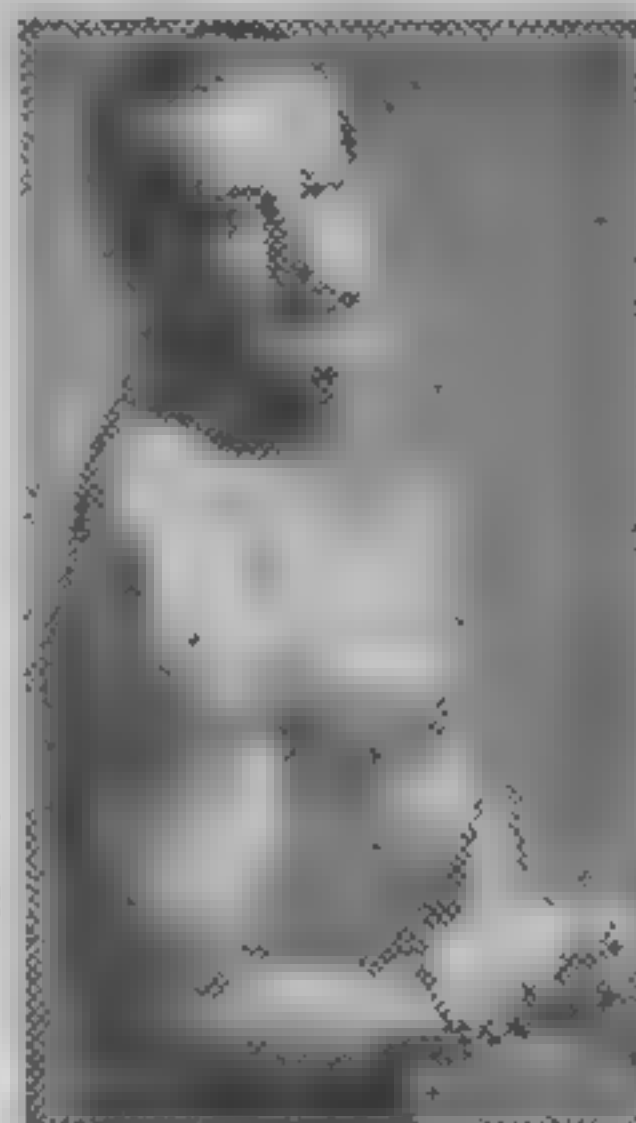
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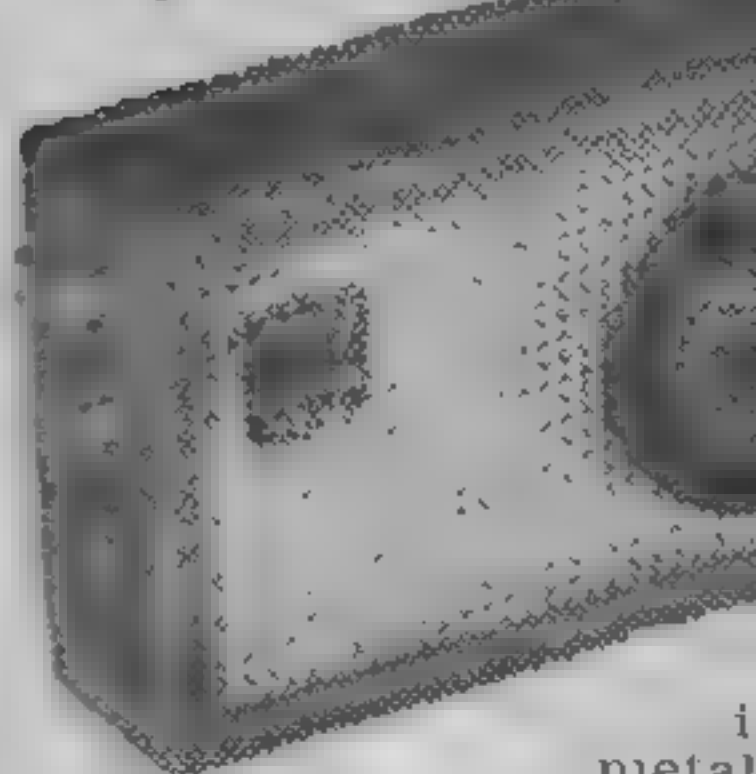
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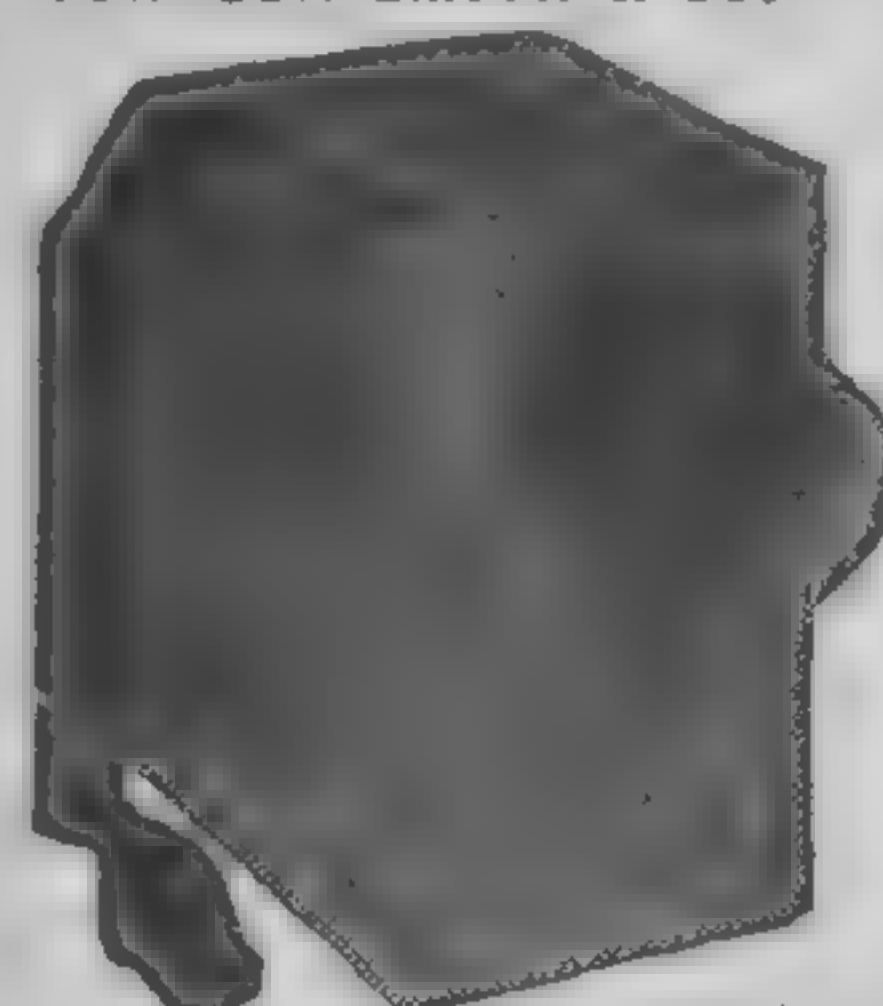


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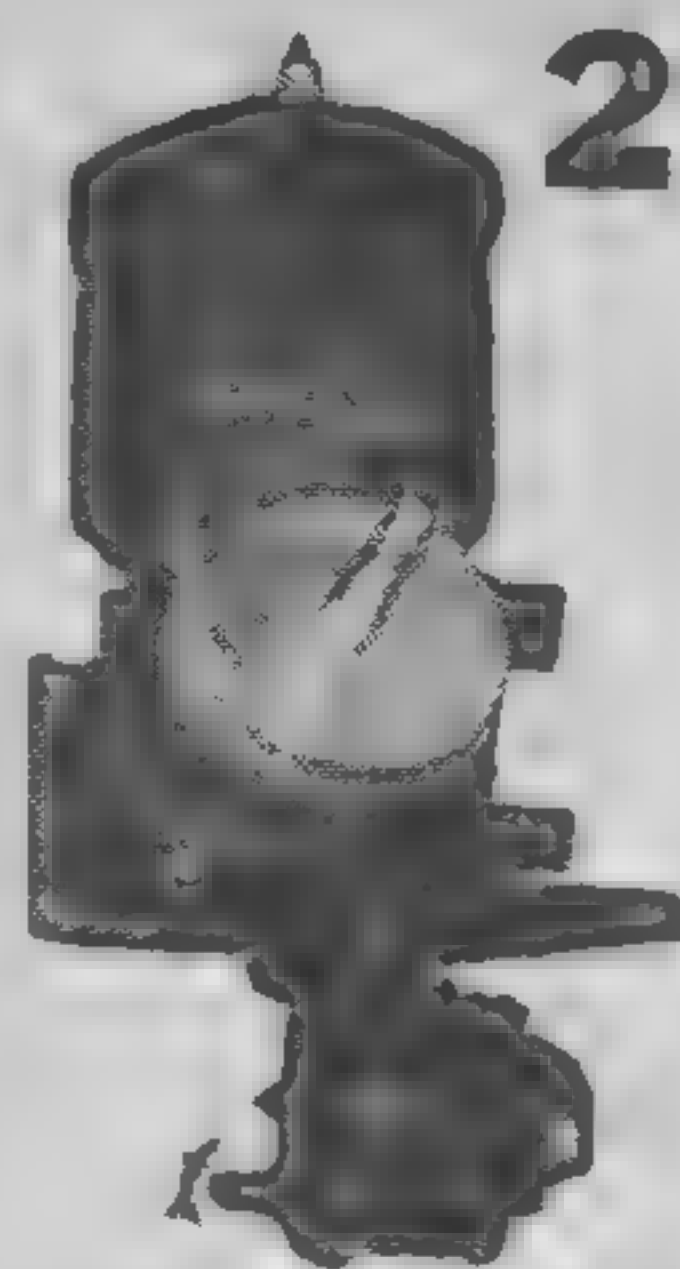
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FOR VETERANS

READERS' ROUND TABLE

This department is conducted by our readers, and every one of you is invited to write for publication. Give us your views, ideas, questions and suggestions, and show and tell your fellow readers about the interesting projects you have built. We want you to feel this is your magazine—a publication shaped by its readers—so don't hesitate to write us frankly just how you like it. Address your letters to Readers' Round Table Science and Mechanics, 450 East Ohio Street, Chicago 11, Illinois.



14.6 on 1/8th Mile

Here's my micro-midget (built from your Craft Print 293) before upholstering. Powered with a re-worked Model 600 Salsbury, it turned 14.6 on a banked 1/8-mile track at Stockton, Kansas, burning straight gasoline.

Had any better looking than this one?
Kenesaw, Nebr. VERNON G. HUNT
None better, Verne.

Jeep-Mounted Welder

To this portable arc welder I built (from your Craft Print 246), I added an ammeter, voltmeter and voltage regulator. I also put a cooling fan on it, hooked in series with a resistor, and a resistor on the rheostat.

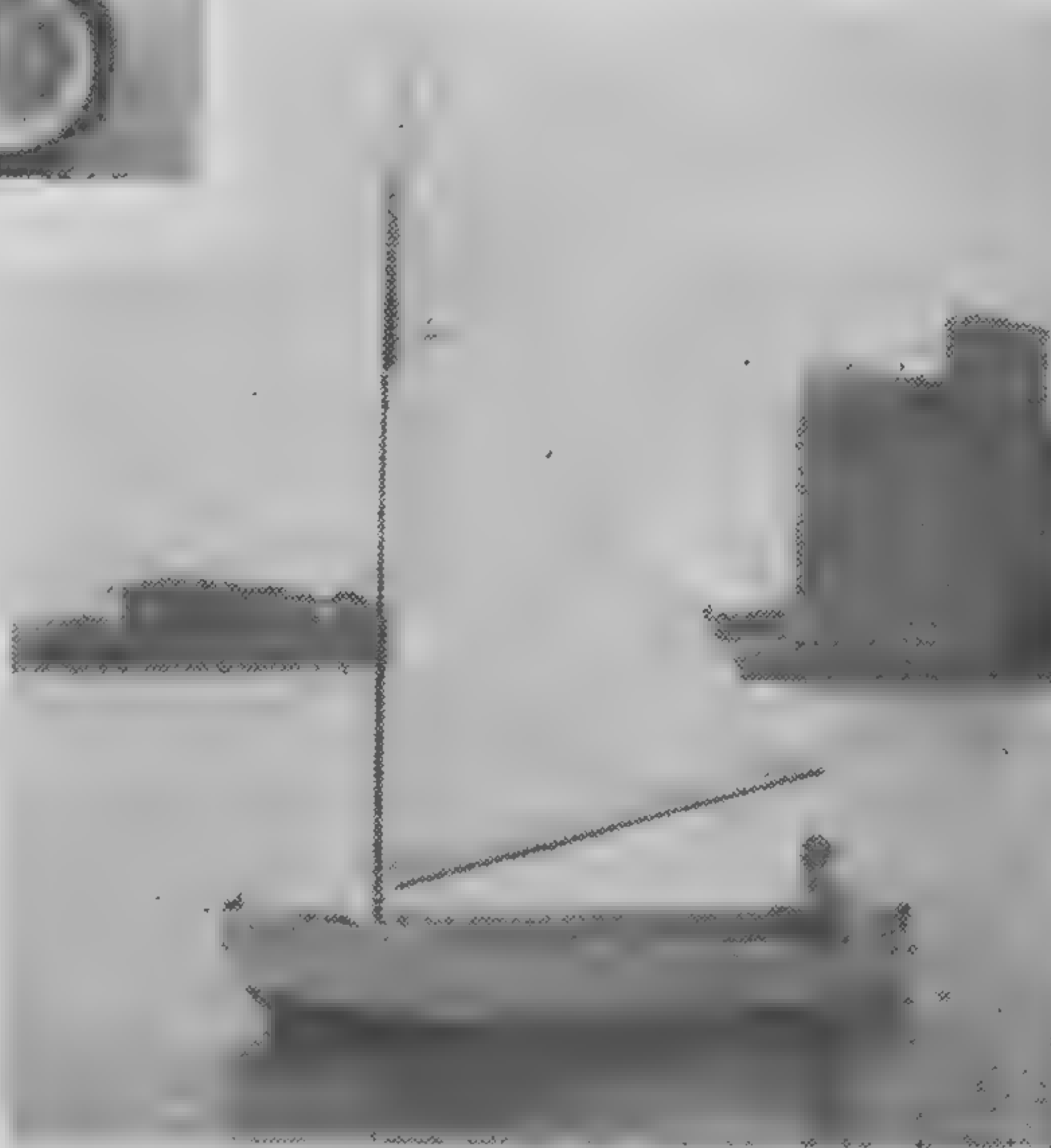
I built a case to keep the dust out and mounted it on the back of my Jeep and it runs

off the power take-off. It works swell.

Thanks for a fine job and a fine magazine.

Route 1, Box 32 GEORGE HUBER
Oroville, Wash.

The fine job is yours, George. You really increased the versatility of the portable welding unit.



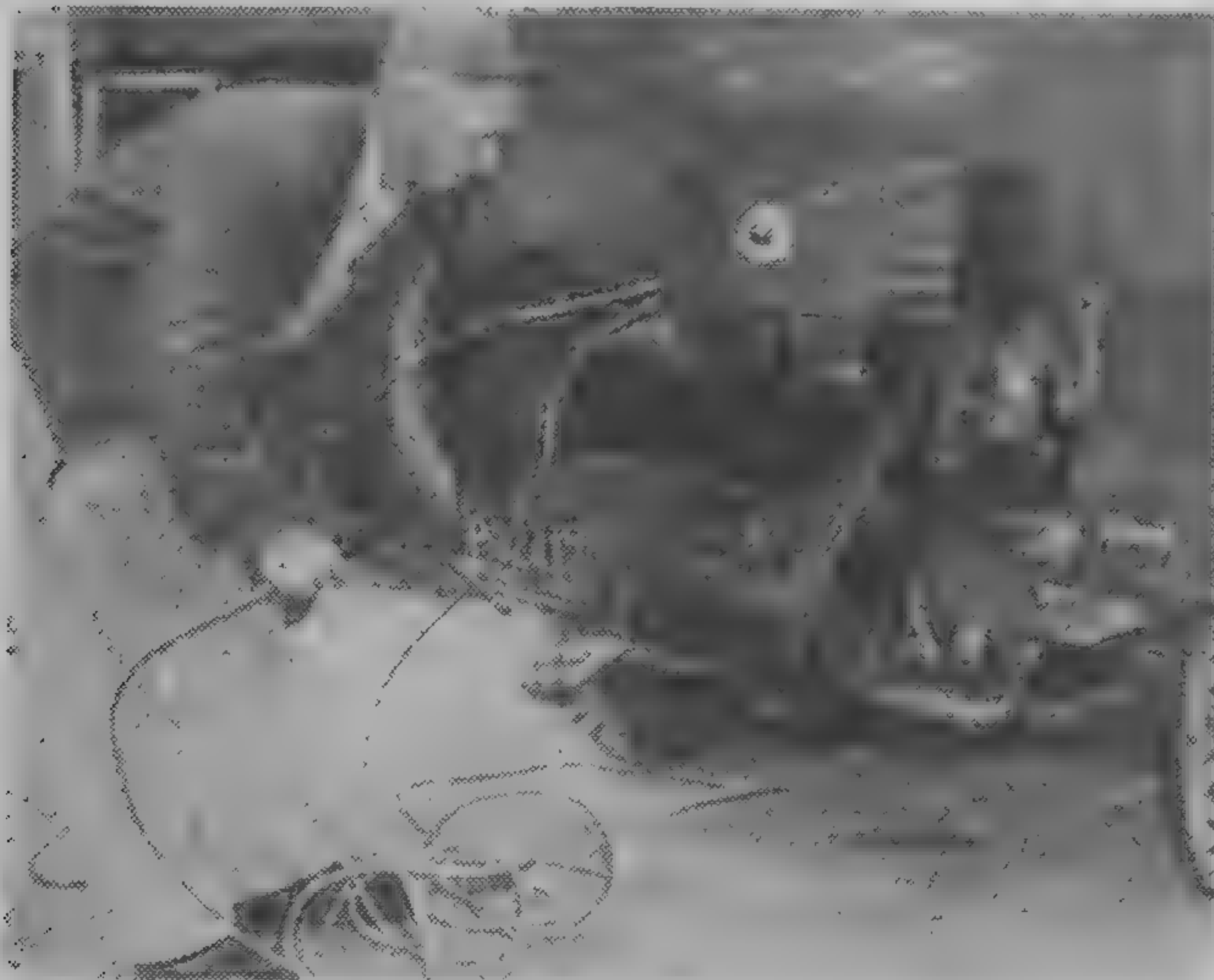
Good Pointer

Built this *Sea Skiff* from your Craft Print 64 and rigged her for sailing using a cutdown Comet sail, mast and boom. Sail area is about 90 sq. ft. and she sails well, making close to hull speed on a reach in a 15 to 20 mph breeze. She points well and moves easily even in a light wind.

Cost of building (excluding sails) was about \$75. The only changes I made were the omission of the skeg, using 1/4-in. steel for the center-board instead of plywood, and fiberglassing the bottom.

Washington Blvd. WILLIAM BUDD
Oswego, N. Y.

Wish more readers would give us reports as complete and interesting as yours, Bill. Thanks.



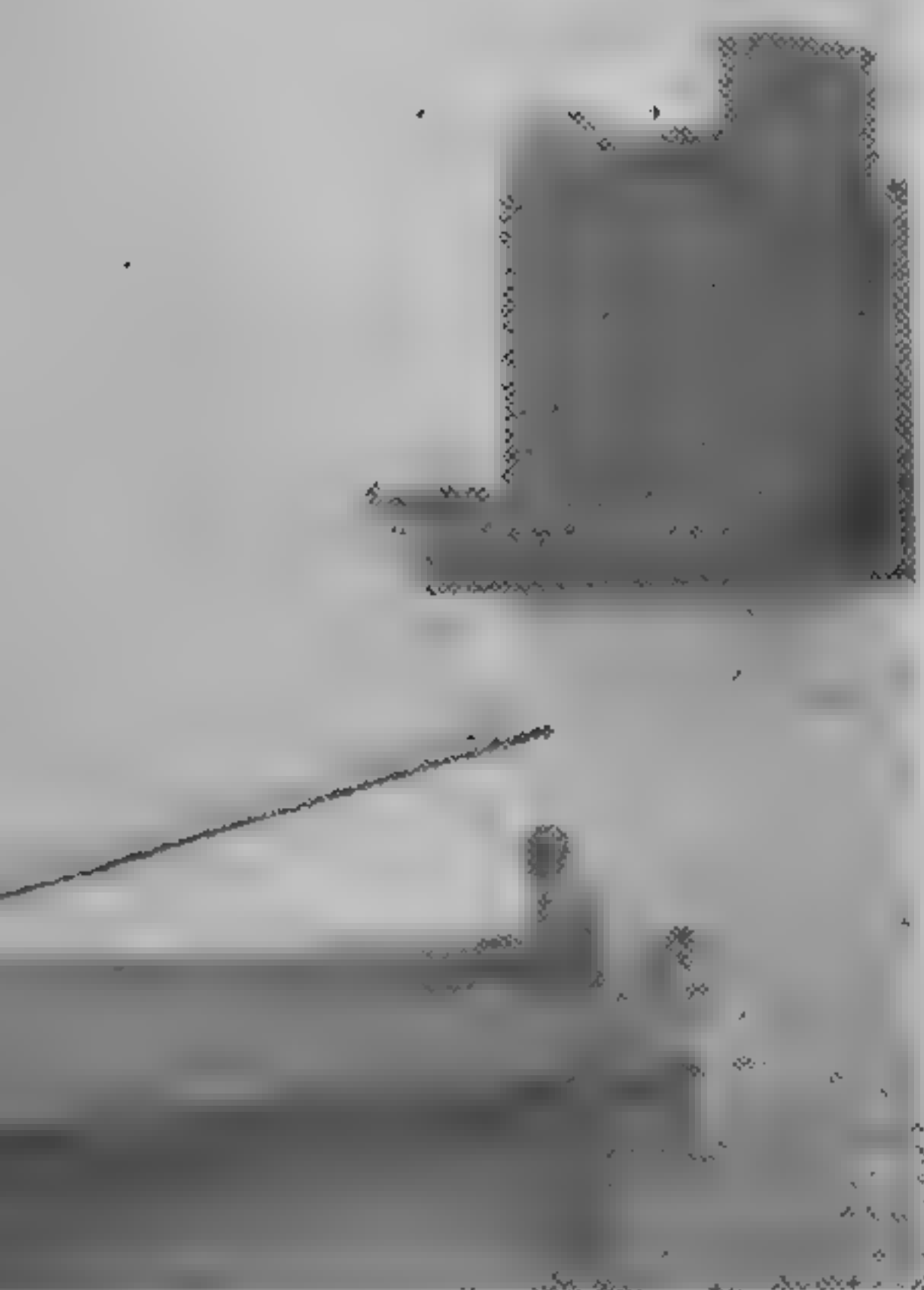
During the past two years, money in revising and modernizing automotive mechanics. If you repair industry, investigate Coupon brings details.—Comu



power take-off. It works
for a fine job and a fine

Box 32 GEORGE HUBER
Wash.

the job is yours, George. You
increased the versatility of the
welding unit.



Pointer

this Sea Skiff from your Craft
and rigged her for sailing
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During the past two years, CTI has invested considerable time and money in revising and modernizing its already famous home training in automotive mechanics. If you are considering a career in this great repair industry, investigate CTI's newer, faster way to get ahead. Coupon brings details.—Commercial Trades Institute, Chicago 26, Ill.

Your Success Story Can Begin Right In Your Own Back Yard

MUST YOU FINISH COLLEGE, leave home, or "start at the bottom" in order to achieve success? We don't think so. There are other ways to get ahead. Good jobs and big money are waiting for ambitious men in the automotive industry. Can you qualify? We feel confident you can, given a little time and sound training.

Be an auto mechanic. Remember that the automotive industry is America's greatest. It needs more skilled mechanics and technicians than any other. Today, the nation can use 100,000 newly-trained mechanics. There's enough repair work to keep 25,000 additional shops busy! Pay scales are attractive. Specialists often share in the profits.

Train at home. You can easily learn this trade at home. CTI sends illustrated, easy-to-understand lessons. You get complete instruction in tune-up and overhaul; electric, cooling and lubricating systems; power steering; power brakes; automatic transmissions; every necessary subject. You even get training in Diesel Mechanics or Body and Fender Rebuilding, at no extra cost.

You get tools and tune-up kit. After a few lessons, you'll want to practice on your own car. To help you put your instruction to work, CTI sends you a set of fine-quality mechanic's tools, and an engine tune-up kit. The kit includes a compression tester; vacuum gauge and fuel pump tester; ignition timing light; and a portable steel case. Seasoned mechanics use these accurate, compactly-designed instruments to locate engine troubles. You pay nothing extra for CTI kits.

Earn cash soon in spare time. Many CTI students fix autos and trucks. They work "on their own", or in neighborhood repair shops. Students earn \$5, \$10, even \$25 a week spare time in this way. They acquire experience along with training. Thus, success begins in a student's back yard!

Mail coupon today for free information. We've told you only part of the story. We'd like to tell you more about the vast auto industry, the desperate need for trained mechanics, the wonderful opportunities for a shop of your own and independence. Please fill out and mail coupon now. Full information will be mailed. No obligation!

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Name _____ Age _____

Address _____

City _____ Zone _____ State _____



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**\$5⁰⁰ an hour
CASH PROFIT**

— Grover Squires



A collection of various tools and equipment arranged vertically. From top to bottom: a hand saw with a wooden handle and a metal blade with teeth; a straight razor with a long handle and a folded blade; a pair of open scissors; a chisel with a wooden handle and a metal head; a hatchet with a wooden handle and a metal head; a pair of lace-up boots with metal skis attached to the soles; a long-handled axe with a metal head and a wooden handle; a pair of open scissors; and a long, thin metal tool, possibly a file or a scraper.

FREE BOOK tells how you can start your own spare time business while you are still working at your regular job. Low Cost—time payments only \$15.00 a month. **Send coupon today.**

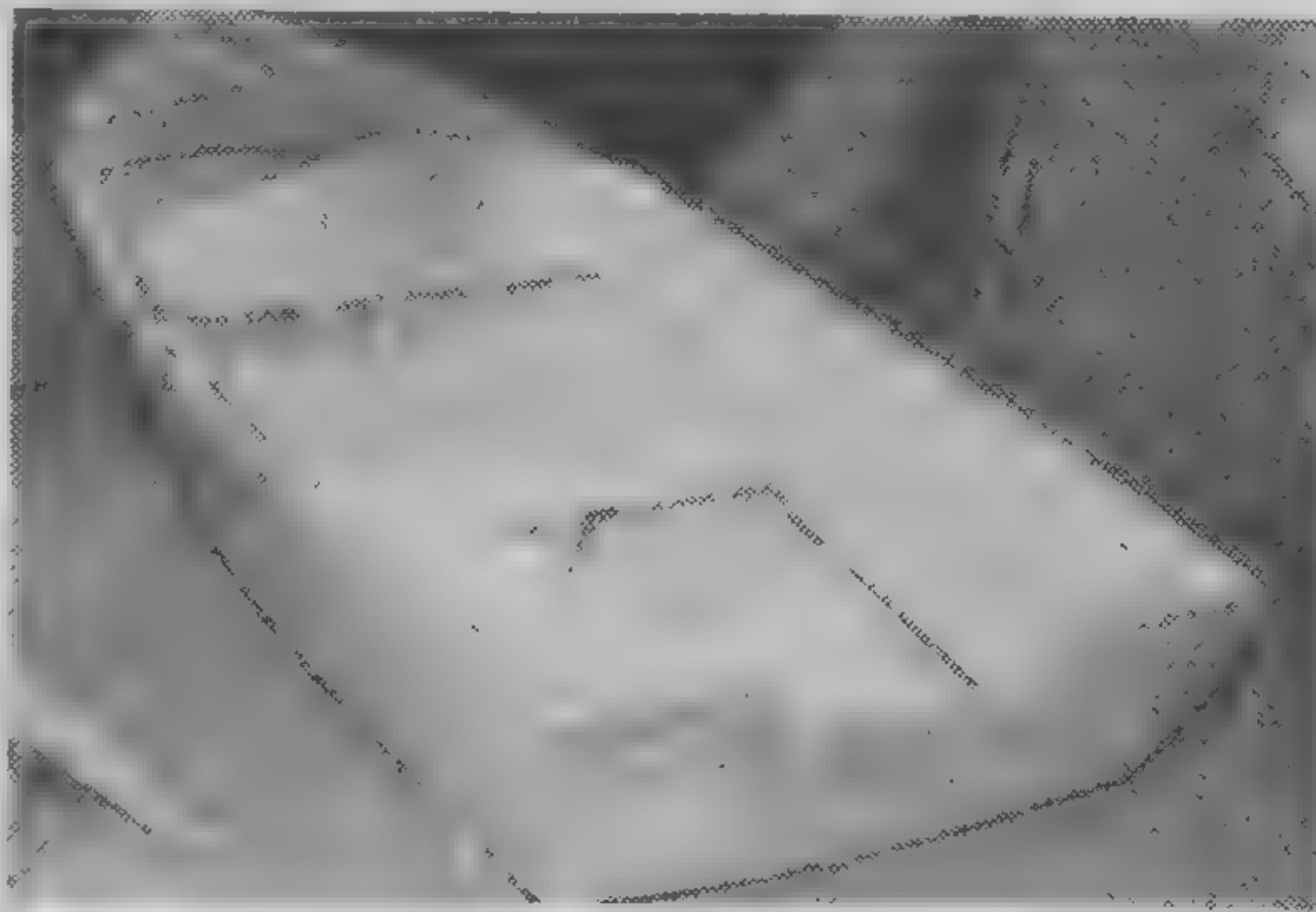


Name _____

Address _____

City _____ State _____

We built this *Minimax* (Craft Print 255) with the four air-tight compartments, fiberglass-taped all joints, and coated all the interior with Kuhls 3-way preservative. With a Scott-Atwater 10-hp motor, the best we can do is 25 mph, recorded on our speedometer. However, this motor has a 6-gallon gas tank which is quite heavy when



MICHAEL J. STANISLOW

MERRILL C. DOWNING

... Last October I installed a set of fire injectors in my '56 Chevy 210 V-8 with P.G. and since then have put about 15,000 miles on them. I have never had them out and they still perform beautifully ... about 19 mpg on a 2,000-mile trip, part of the time bucking a head wind. I put a set of injectors in our '51 Chevy too, and haven't had any trouble at all since putting them in—about



I Have All The Mon

In my own life I have gone
of money. I have it. I have
the need of gain. I have two
pay me an income well above
I have need for. And, in a
the satisfaction—the deep
knowing that I have put n
hundred other men in busi
own. Since I have no need
greatest satisfaction I get fr
my secret of personal ind
others—seeing them achie
heights of happiness that h
my own life.

Please don't misunderstand me. I am not a philanthropist. Charity is something that no man will accept. I have never seen a man who was worth his salt who

c (Craft Print 255) with
rtments, fiberglass-taped
the interior with Kuhls
h a Scott-Atwater 10-hp
do is 25 mph, recorded
however, this motor has a
h is quite heavy when



a special 2-gallon tank to
heel; this will take about
the boat and, I hope, give
ed.

S&M, page 54) sure gets
do, and we contacted Gil
n increasing the speed of

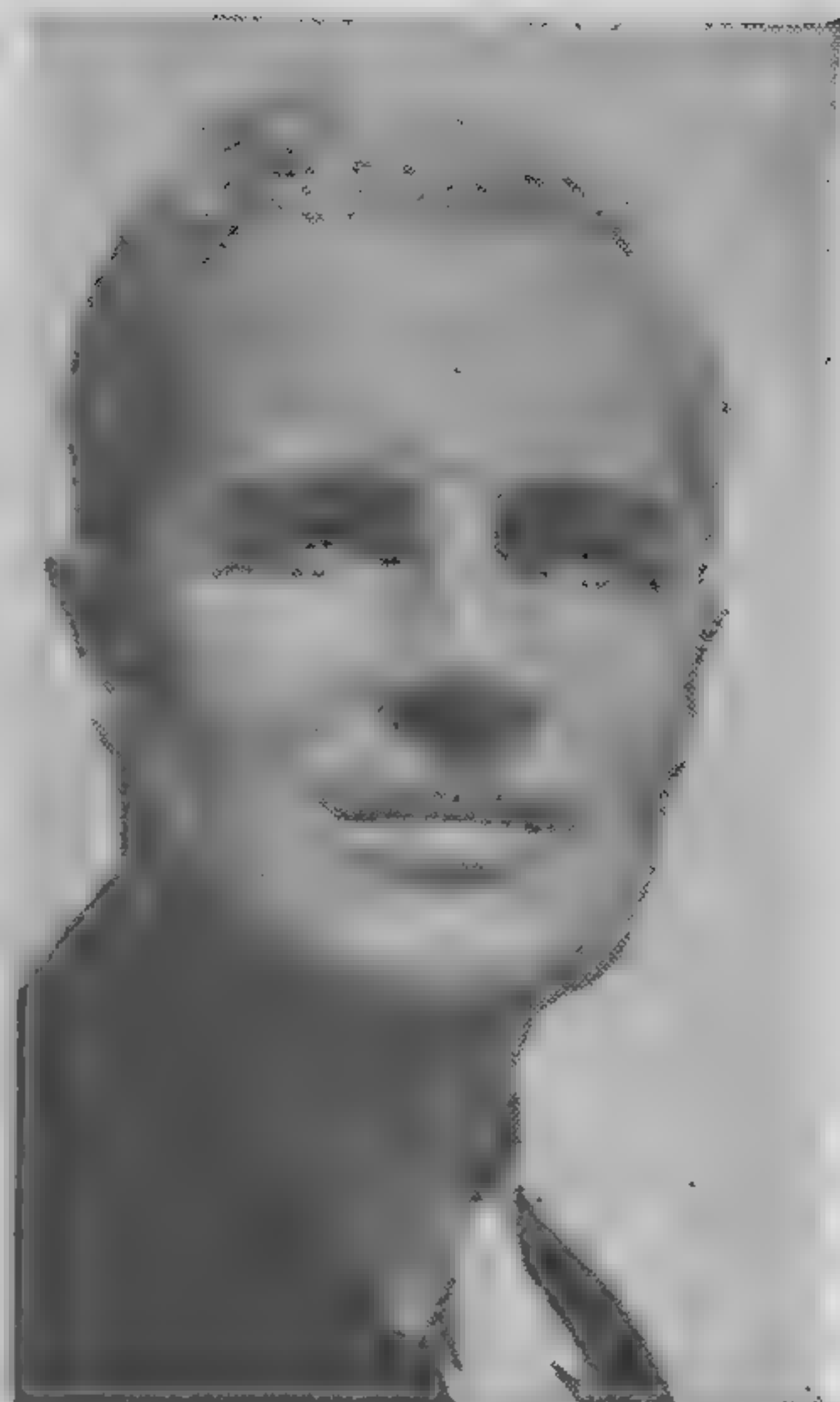
MICHAEL J. STANISLOW

will give you the best ad-
ound Table members are
ce've found.

niters and Injectors
ters regarding spark plugs,
(Oct. '58 S&M), I do not
ased a set of injectors and
et over 40 mph before they
took them out and put the
d the car ran perfectly. I
h with 10,000 miles on it.
time to have the valves,
g checked and new points
decided I would give the
ce so took out the old plugs
ctors again. The same old
ck and motor missed like
te the company but never

MERRILL C. DOWNING

installed a set of fire in-
vey 210 V-8 with P.G. and
about 15,000 miles on them.
n out and they still perform
19 mpg on a 2,000-mile trip,
ng a head wind. I put a set
Chevy too, and haven't had
nce putting them in—about



I am printing my message in a maga-
zine. It may come to the attention of
thousands of eyes. But of all those
thousands, only a few will have the
vision to understand. Many may read;
but of a thousand only you may have
the intuition, the sensitivity, to under-
stand that what I am writing may be
intended for you—may be the tide that
shapes your destiny, which, taken at
the crest, carries you to levels of inde-
pendence beyond the dreams of avarice.

Don't misunderstand me. There is
no mysticism in this. I am not speak-
ing of occult things; of innumerable
laws of nature that will sweep you to
success without effort on your part.
That sort of talk is *rubbish!* And any-
one who tries to tell you that you can
think your way to riches without effort
is a false friend. I am too much of a
realist for that. And I hope you are.

I hope you are the kind of man—if
you have read this far—who knows
that anything worthwhile has to be
earned! I hope you have learned that
there is no reward without effort. If
you have learned this, then you may be
ready to take the next step in the
development of your karma—you may
be ready to learn and use the secret I
have to impart.

I Have All The Money I Need

In my own life I have gone beyond the need
of money. I have it. I have gone beyond
the need of gain. I have two businesses that
pay me an income well above any amount
I have need for. And, in addition, I have
the satisfaction—the deep satisfaction—of
knowing that I have put more than three
hundred other men in businesses of their
own. Since I have no need for money, the
greatest satisfaction I get from life, is shar-
ing my secret of personal independence with
others—seeing them achieve the same
heights of happiness that have come into
my own life.

Please don't misunderstand this state-
ment. I am not a philanthropist. I believe
that charity is something that no proud
man will accept. I have never seen a man
who was worth his salt who would accept

I'd like to give this to my fellow men... while I am still able to help!

I was young once, as you may be—today
I am older. Not too old to enjoy the fruits
of my work, but older in the sense of being
wiser. And once I was poor, desperately
poor. Today almost any man can stretch
his income to make ends meet. Today,
there are few who hunger for bread and
shelter. But in my youth I knew the pinch
of poverty; the emptiness of hunger; the
cold stare of the creditor who would not
take excuses for money. Today, all that
is past. And behind my city house, my

summer home, my Cadillacs, my Winter-
long vacations and my sense of independ-
ence—behind all the wealth of cash and
deep inner satisfaction that I enjoy—there
is one simple secret. It is this secret that
I would like to impart to you. If you are
satisfied with a humdrum life of service
to another master, turn this page now—
read no more. If you are interested in a
fuller life, free from bosses, free from
worries, free from fears, read further.
This message may be meant for you.

By Victor B. Mason

something for nothing. I have never met a
highly successful man whom the world re-
spected who did not sacrifice something to
gain his position. And, unless you are will-
ing to make at least half the effort, I'm not
interested in giving you a "leg up" to the
achievement of your goal. Frankly, I'm
going to charge you something for the
secret I give you. Not a lot—but enough to
make me believe that you are a little above
the fellows who merely "wish" for success
and are not willing to sacrifice something
to get it.

A Fascinating and Peculiar Business

I have a business that is peculiar—one of
my businesses. The unusual thing about it
is that it is needed in every little community
throughout this country. But it is a busi-
ness that will never be invaded by the "big
fellows". It has to be handled on a local
basis. No giant octopus can ever gobble up
the whole thing. No big combine is ever
going to destroy it. It is essentially a "one
man" business that can be operated with-
out outside help. It is a business that is
good summer and winter. It is a business
that is growing each year. And, it is a busi-
ness that can be started on an investment
so small that it is within the reach of anyone
who has a television set. But it has nothing
to do with television.

This business has another peculiarity. It
can be started at home in spare time. No
risk to present job. No risk to present in-
come. And no need to let anyone else know
you are "on your own". It can be run as a
spare time business for extra money. Or,
as it grows to the point where it is paying
more than your present salary, it can be
expanded into a full time business—over-
night. It can give you a sense of personal
independence that will free you forever
from the fear of lay-off, loss of job, depres-
sions, or economic reverses.

Are You Mechanically Inclined?

While the operation of this business is
partly automatic, it won't run itself. If you
are to use it as a stepping stone to inde-
pendence, you must be able to work with
your hands, use such tools as hammer and
screw driver, and enjoy getting into a pair
of blue jeans and rolling up your sleeves.
But two hours a day of manual work will
keep your "factory" running 24 hours turn-

ing out a product that has a steady and
ready sale in every community. A half
dollar spent for raw materials can bring
you six dollars in cash—six times a day.

In this message I'm not going to try to
tell you the entire story. There is not
enough space on this page. And, I am not
going to ask you to spend a penny now to
learn the secret. I'll send you all the in-
formation, free. If you are interested in
becoming independent, in becoming your
own boss, in knowing the sweet fruits of
success as I know them, send me your
name. That's all. Just your name. I won't
ask you for a penny. I'll send you all the
information about one of the most fascinat-
ing businesses you can imagine. With these
facts, you will make your own investigation.
You will check up on conditions in your
neighborhood. You will weigh and analyze
the whole proposition. Then, and then only,
if you decide to take the next step, I'll
allow you to invest \$15.00. And even then,
if you decide that your fifteen dollars has
been badly invested I'll return it to you.
Don't hesitate to send your name. I have no
salesmen. I will merely write you a long let-
ter and send you complete facts about the
business I have found to be so successful.
After that, you make the decisions.

Does Happiness Hang on Your Decision?

Don't put this off. It may be a coincidence
that you are reading these words right now.
Or, it may be a matter that is more deeply
connected with your destiny than either of
us can say. There is only one thing certain:
If you have read this far you are interested
in the kind of independence I enjoy. And if
that is true, then you must take the next
step. No coupon on this advertisement. If
you don't think enough of your future hap-
piness and prosperity to write your name
on a postcard and mail it to me, forget the
whole thing. But if you think there is a
destiny that shapes men's lives, send your
name now. What I send you may convince
you of the truth of this proverb. And what
I send you will not cost a penny, now or at
any other time.

VICTOR B. MASON
1512 Jarvis Ave., Suite M-5-B
CHICAGO 26, ILLINOIS

4,000 miles ago. Both cars perform equally well in both high and low speeds. . . .
3615 Enumclaw Highway RICHARD WELLER
Auburn, Wash.

. . . I couldn't leave my set of fuel igniters in my '55 V-8 Packard 400 long enough to test mileage. The skip, buck, jump and jerk were so bad I replaced the old plugs.
601 Samford Ave. IVAN R. MARTIN
Auburn, Ala.

My car is a 1951 Ford 6 cylinder standard transmission. Have used the Fire Injectors about four months.

Recently made a trip of about 4,000 miles with no trouble, easy starting every morning, no miss at high speed. That includes city driving and high speed highway traveling at 70 mph plus. . . . Plugs have not been removed from car since.
2572 Natural Bridge Ave. KAI HOLST
St. Louis 7, Mo.

. . . I had a set of fuel igniters. They did not perform as in their ads. The Better Business Bureau helped obtain return of my money.
63 Wildwood St. MORRIS LIPMAN
Mattapan 26, Mass.

. . . Last spring I put a set of fire injectors in my 1954 Ford 6 and made a 2,709-mile trip . . . could see no difference in performance . . . aver-

aged 18 mpg. I returned them to the company and received my refund of purchase price . . . I replaced my old plugs and drove them a few more months and then before going on a trip this month I had them taken out and cleaned. This trip was for 2,774 miles and with these old plugs I averaged 19.4 mpg. . . .
Madison MERLIN E. HIARING
South Dakota

. . . Have had igniters in a '49 Plymouth for 15,000 miles plus. I've had one out to look at it then put it back. That car starts just as easy now as the day I put them in, with points that are older yet. This car has over 100,000 miles on it, and runs hot due to a radiator that isn't too clean. I ran the starter plenty to start with plugs [conventional] when she got hot, but it doesn't bother these igniters a bit. . . .
Route 1, Box 38-A HAROLD J. HANN
Buckley, Wash.

. . . I gave the fire injectors a 1,300-mile trial in hot country and with real hardship driving. I had driven this approximate trip several times with spark plugs and my mpg average was 17. With the fire injectors, it was 12 mpg. I took them out and sent them back, for inspection, as one had suffered damage around the porcelain core; the plugs were inspected and a new one replaced the damaged one.

I did get a lot less mileage, but I did not have

Sworn statement from CHAS. LEMMING reads:

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I've averaged \$100 A DAY —most of it clear profit!"

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Address _____

City _____ Zone _____ State _____

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In city of less than 50,000, Mr. Lemming started his own business after filling in coupon like one below. He averaged \$100 a day during first year, some days \$200. F. E. Doran grossed \$1050 in single month. Geo. Held grossed \$300 in one week.

How much you earn depends largely on you. No special skill, no large investment required for our electric upholstery cleaning machine. Start spare time until full time justified. Hire helpers as needed.

NO SHOP NECESSARY • You clean upholstered furniture on customers' premises—homes, hotels, motels, etc. Auto upholstery, too. No hauling; operate from your home. Watch business grow as satisfied customers tell friends. Supplies cost little, profits high.



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• Easy-to-play music • M
• Name in chrome letters
• Deluxe Case • Music P
Plus Other Valuable G

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Full or part time—
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restaurant, hotel, etc.,
repeat customers. Write
Today for proven daily
profit plan. Guaranteed.

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NOW



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Autos...\$78 Planes...
Boats...\$5.90 Fk-Lift...
Trucks...\$212 Generator...
Hoists...\$3.68 Compressor...
Motors...99¢ Hyd. Cyls...
Tractor...\$68 Gear Box...

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small g
Guaranteed.
Order NOW fr
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d them to the company
d of purchase price . . .
s and drove them a few
efore going on a trip this
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and with these old plugs

MERLIN E. HIARING

s in a '49 Plymouth for
had one out to look at it
ar starts just as easy now
in, with points that are
over 100,000 miles on it,
adiator that isn't too clean.
to start with plugs [con-
t hot, but it doesn't bother

HAROLD J. HANN

injectors a 1,300-mile trial
with real hardship driving.
approximate trip several
and my mpg average was
tors, it was 12 mpg. I took
em back, for inspection, as
age around the porcelain
inspected and a new one
one.

mileage, but I did not have

ads:

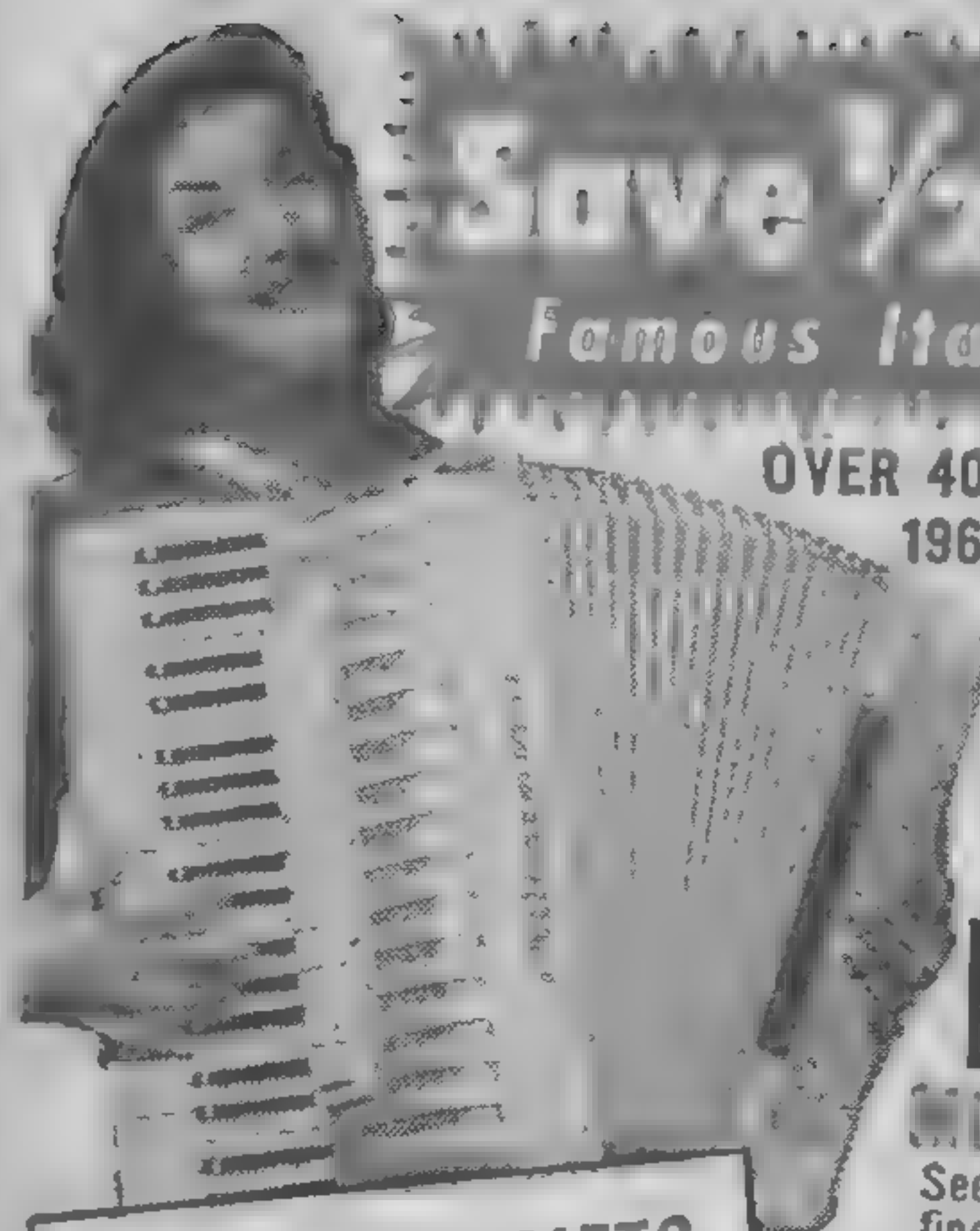
aged
A
DAY
clear profit!"

ll...
machines

Mr. Lemming started his
a coupon like one below.
ring first year, some days
\$1050 in single month.
one week.

pends largely on you. No
estment required for our
machine. Start spare time
re helpers as needed.

a clean upholstered furni-
es—homes, hotels, motels,
. No hauling; operate from
ess grow as satisfied cus-
es cost little, profits high.



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tional values! Prices slashed on all our fine Italian-Made accordions! Here's
your opportunity of a lifetime to play the most popular instrument of all.
Have fun, be a leader! Choose from 40 newest models that lead the world
in superb tone and breathtaking beauty. All latest improvements and fea-
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turer's list prices. Small down payment; pay the balance on easiest terms.
Big trade-in allowances. Try before you buy on **FREE 5-DAY NO RISK**
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for promptness . . .

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- Name in chrome letters
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Today for proven daily
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ment and supplies, radio, electronic and electrical equipment, trucks, boats, air-
planes. Plumbing, hardware, office equipment and supplies. Tools, machinery,
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to pay. Send \$1 **TODAY** for "Government Surplus Directory."

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to replace them two or three times on the trip, as I had had to do before, with conventional spark plugs. . . .
2127 Brewster Pl.
Bremerton, Wash.

C. E. DIXON

. . . At low mileage (20-35) I seem to get approximately 2 extra mpg. From 35-45 mph, the mileage dropped to about one mpg extra. Above that, there never has been any indication that the injectors were giving me better mileage . . . I have done approximately 19,000 miles with the injectors. . . . Several times during the period, the mechanic has taken one or more of the injectors out, and found them to be quite clean. . . .
Pleasantville, N. Y.

J. LEON CORT

Because we were informed that a manufacturing change was pending we abandoned the "wear" tests we were running on igniters and waited until samples of the new igniters were available. They are now being used in new tests already under way, and we hope to be able to publish a report on them for you soon.

Where's the Big Top?

I would like to have more plans on circus wagons. I have eight wagons complete with harness horses—20 horses in all.

I have had them on display in several places. I



received blue ribbons at the San Diego County Fair Hobby Show and the San Diego Park and Recreation Hobby and Craft Show.

What happened to the Big Top? Could you also let me know if plans for more circus wagons and also drivers and helpers could be had someplace?

How about the old Roman Chariot?

P. O. Box 613

DONALD McDONALD

San Diego, Calif.

That Big Top project has never been completed, sad to say. But it is still being worked on, Don, and we'll publish it as soon as it is complete.

Science Fair Judging

. . . I want to congratulate your magazine on running the October issue article (*What It Takes to Create Winning Science Projects*), and Mr. Dinwiddie on an excellent job of reporting.

Possibly the worst problem facing a judge at such a fair is that of selecting a first-place winner from several equally meritorious projects and exhibits. After participating in the judging at the Hartford Fair, I had the feeling that the differ-



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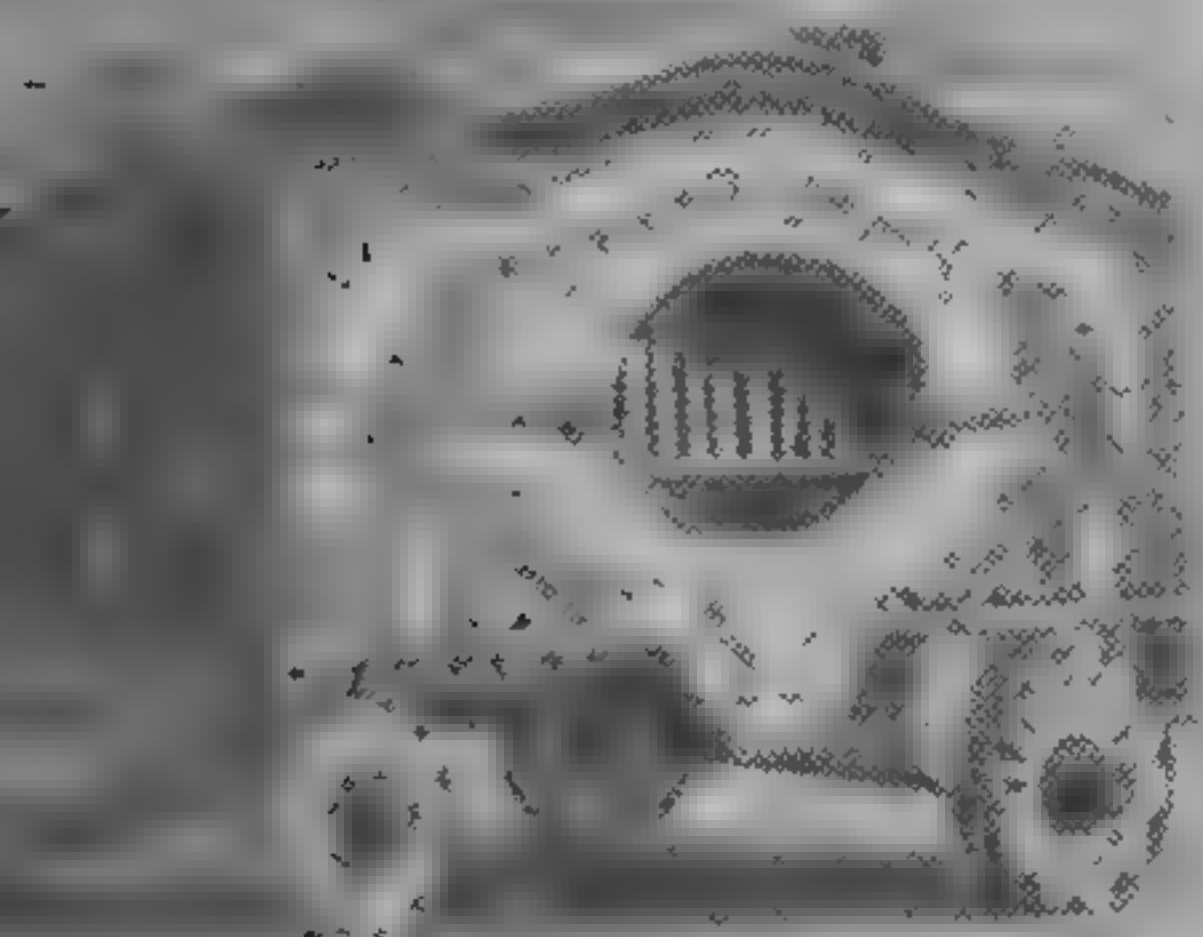
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C. E. DIXON

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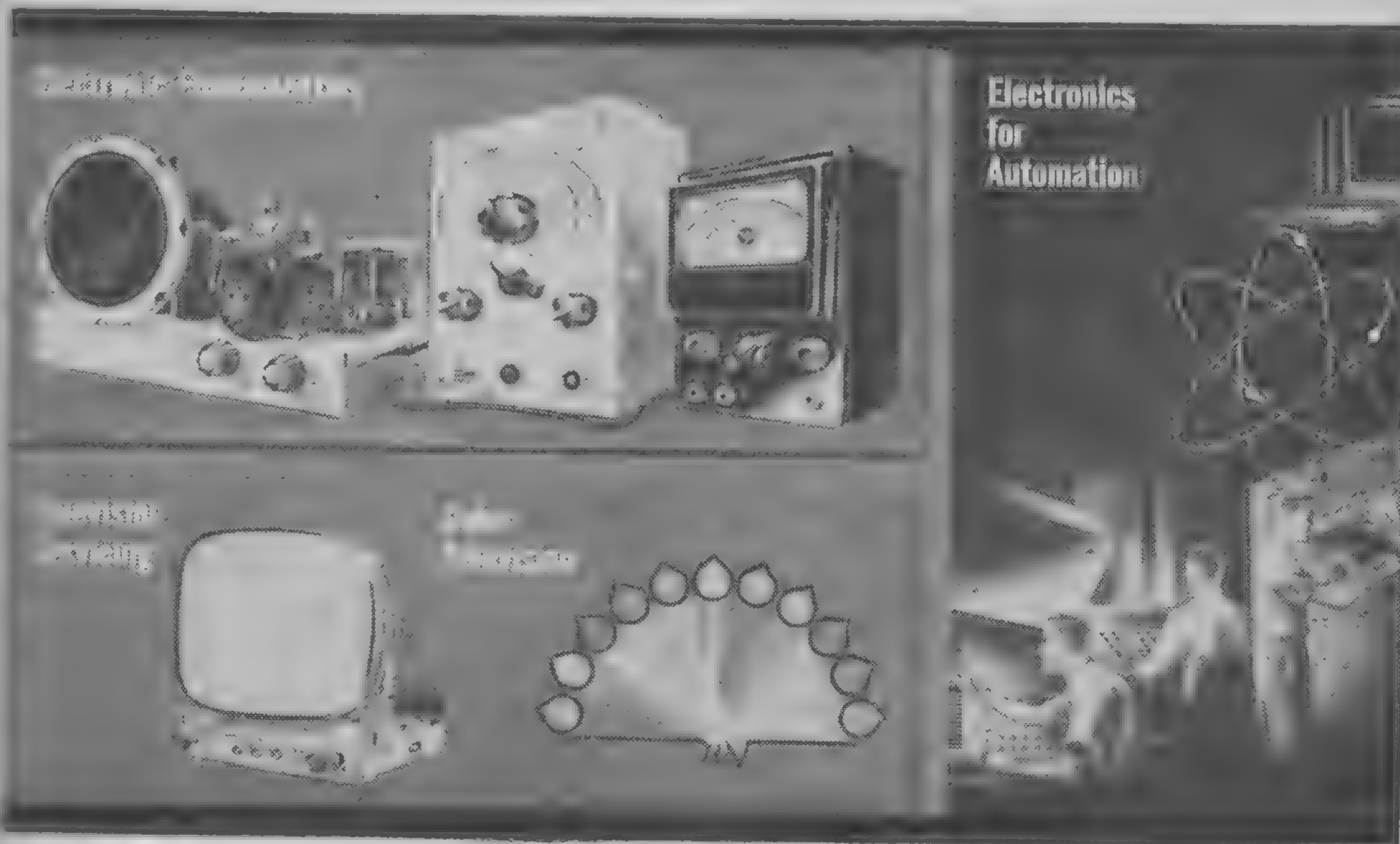


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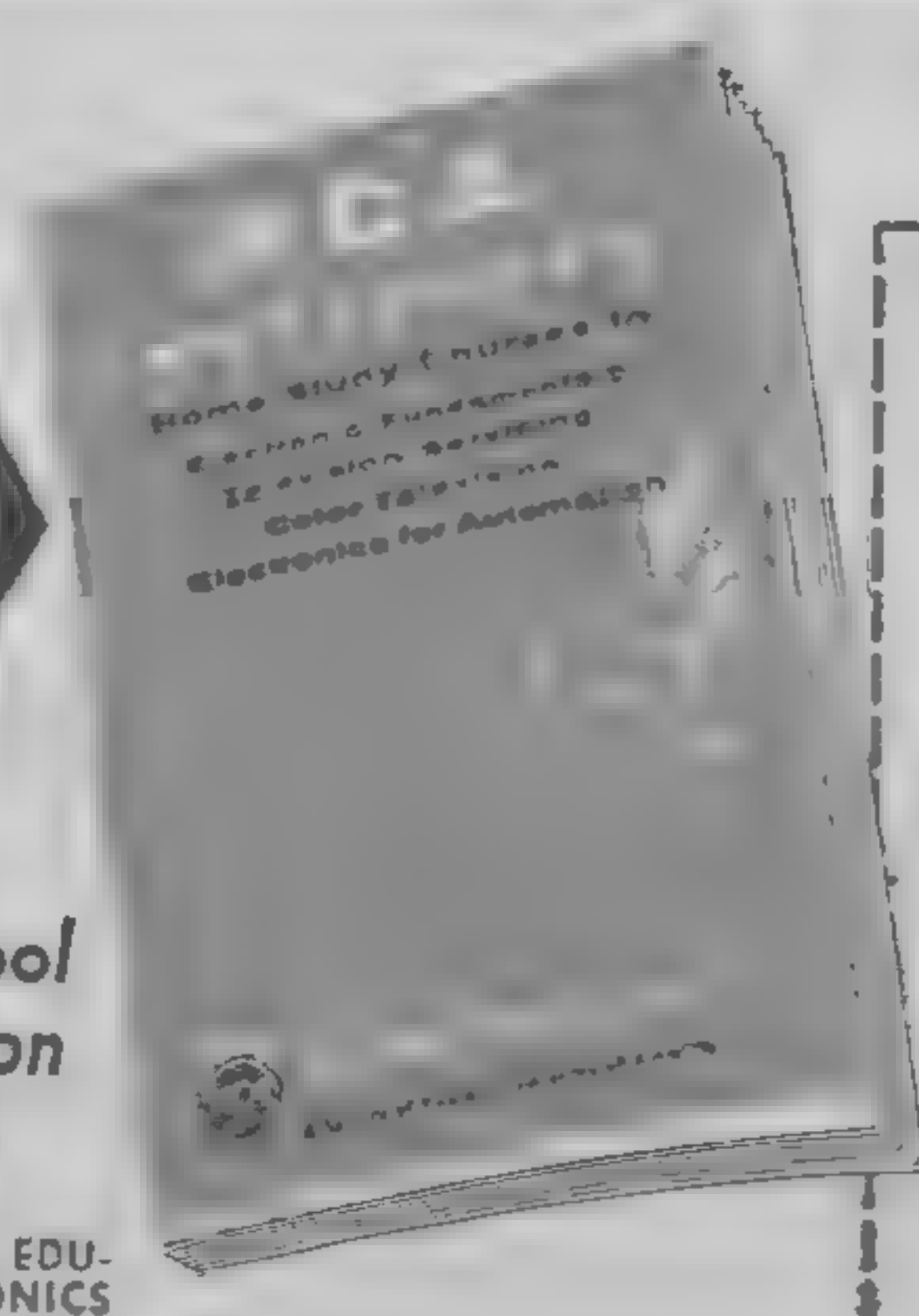
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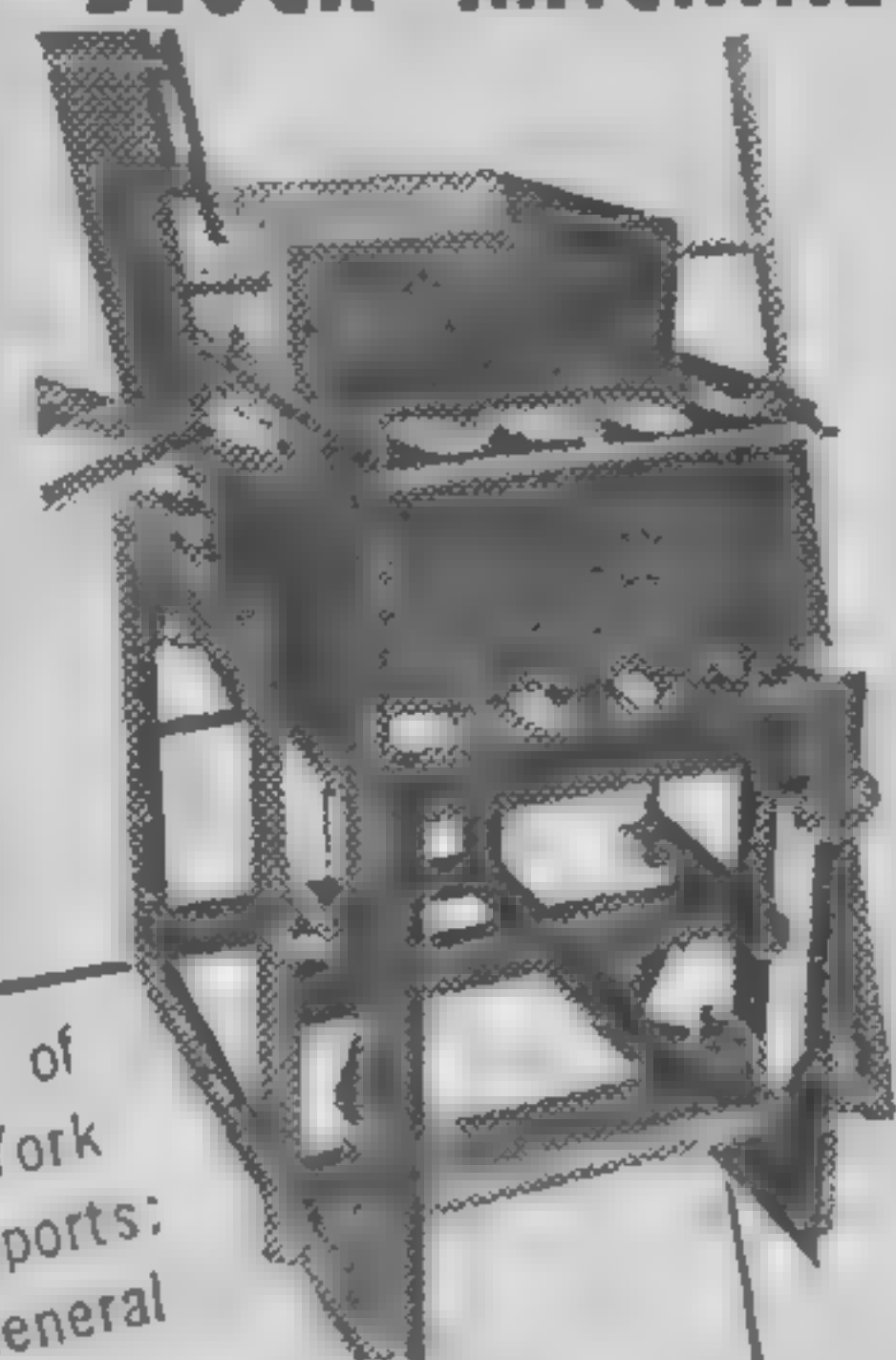
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ence in quality between first place and the other places was very small indeed. For this particular fair, anyone who received special recognition must certainly be considered a competent future scientist.

The Connecticut Agricultural
Experiment Station
New Haven, Conn.

NEELY TURNER
Chief Entomologist

... a very fine job, in my opinion.

1719 "N" St. NW JOSEPH H. KRAUS, Coordinator
Washington, D.C. National Science Fair

I have enjoyed reading the article, *What It Takes to Create Winning Science Projects*. You have given a very fair appraisal of the 1959 National Science Fair. I like especially your emphasis on the characteristics of a good science fair project. ... Far too many science fair projects involve mere construction and do not exhibit anything which is very close to real research.

State Dept.
of Education
Hartford, Conn.

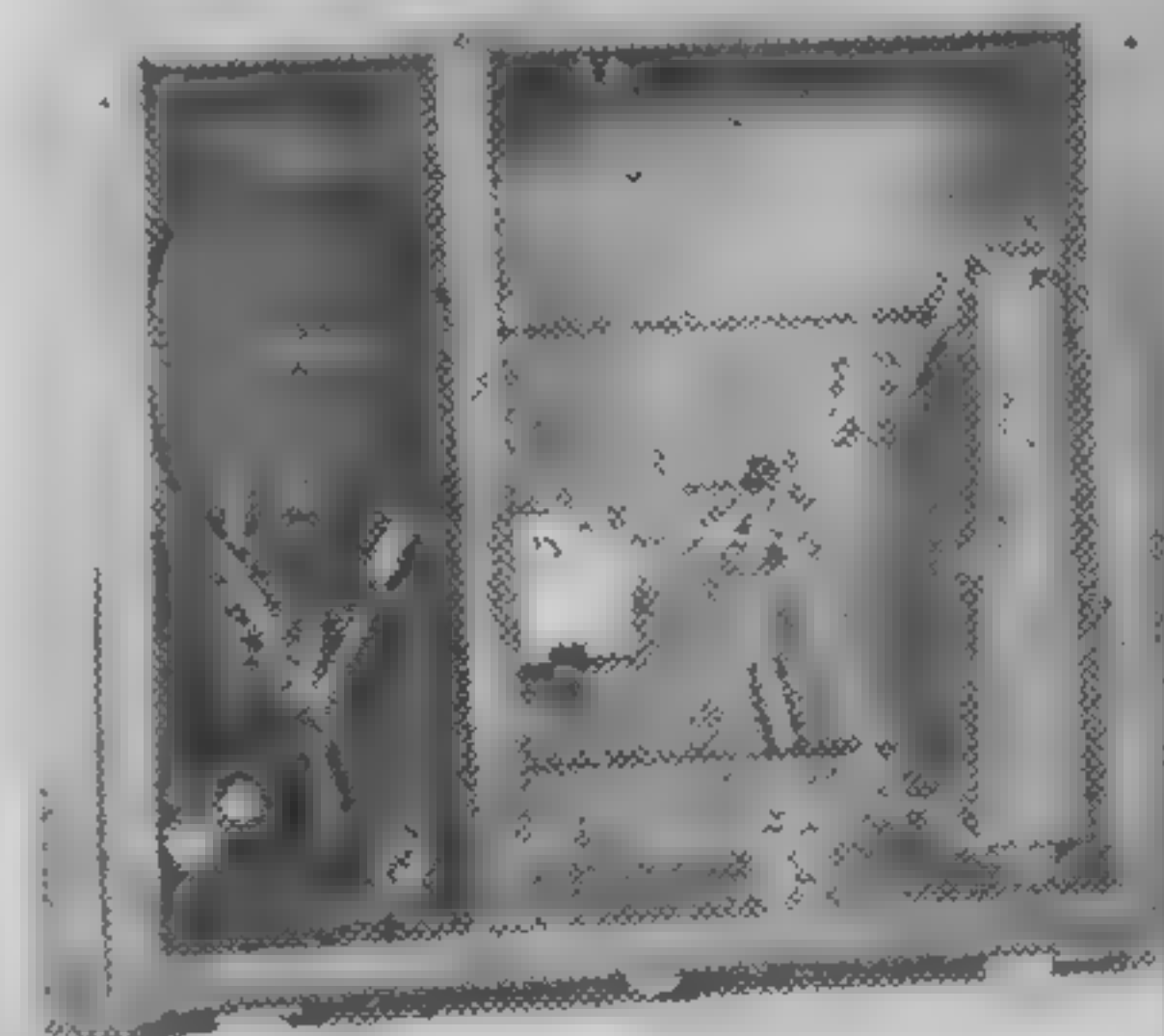
RALPH E. KAIRSTEAD
Consultant in Science
Education

Pivoting Battery Box



I made the *Transistorized Loop Receiver* (Oct. '59 S&M) in our Shop class at school. ... During the building it attracted much attention, and later, when completed, all the kids wanted to try it out. Altogether it cost about \$4.

I didn't need all the room inside because I have a pair of the miniature earphones. So I made the case 10 x 10-in. instead of 10 x 13-in., and compensated for this change by adding three full turns of aerial wire and tapping on the 12th. This works unusually well. Also, instead of gluing the battery box I put a wood screw (1 1/4 in. long)



about half way down putting it on a pivot.

ing the three penligh
Am almost finished
the same issue). It's
about some small tra
16656 Monte Vista
Detroit 21, Michigan

There'll be some,

South of the Border

Concerning the Old
S&M) I am already an
V-77 ... I have heard
have had a 450 hp Pra
the 300 Lycoming my
this a good sound pla
ance seems slow. Is t
approved by FAA? I
since I have never be
specs on this plane.
Aeropuerto Las Piedra
Punto Fijo—Caja de A
Estado Falcon
Venezuela

Sorry, but the FAA
than the original has o
Many V-77s (Army des
for England in WW II
some with the 450 as
agents privately susp
some as compared w
versions. They say the
some hours of test flig
prove quite costly. W
wing, much heavier th
never had a really fas
slow climb you menti
the temperatures and f
operate.

The Right Connection

Liked your article
(Aug. '59 S&M). Howe
(page 168) is employ
Delco Remy systems,
between the battery and
points (unless the star
these units the jumper
very to the battery side
3511 W. 77th St.
Chicago, Ill.

Right you are, Bill.
special note covering t

Burn Up S&M's?

If any reader is goin
would he mind sending
and any aviation articl

How about compiling
ports for aviation bugs
clude a 3-view drawing
Rt. 2 Box 26
Alvarado, Texas

How many Round Ta
-y's motion?

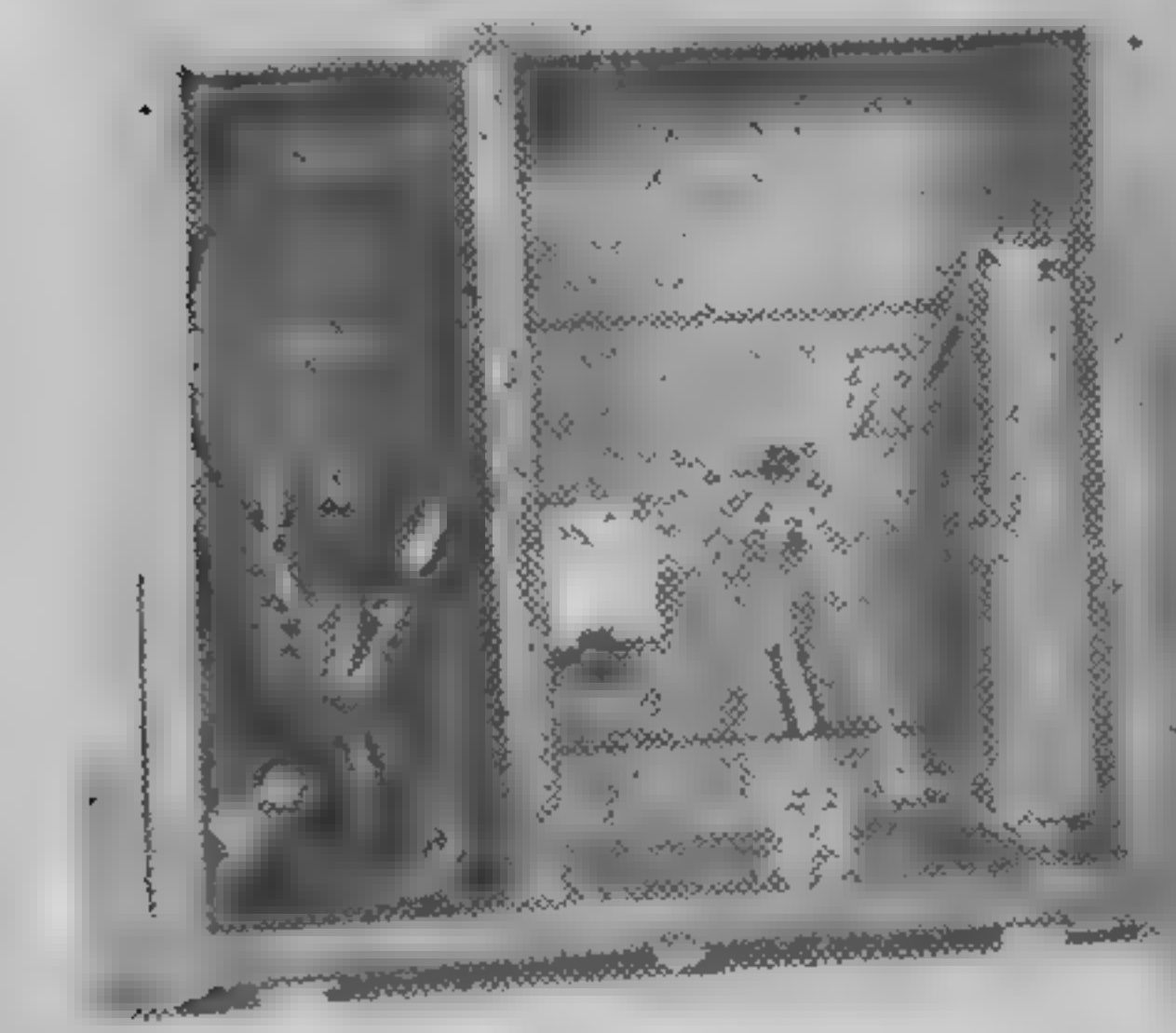
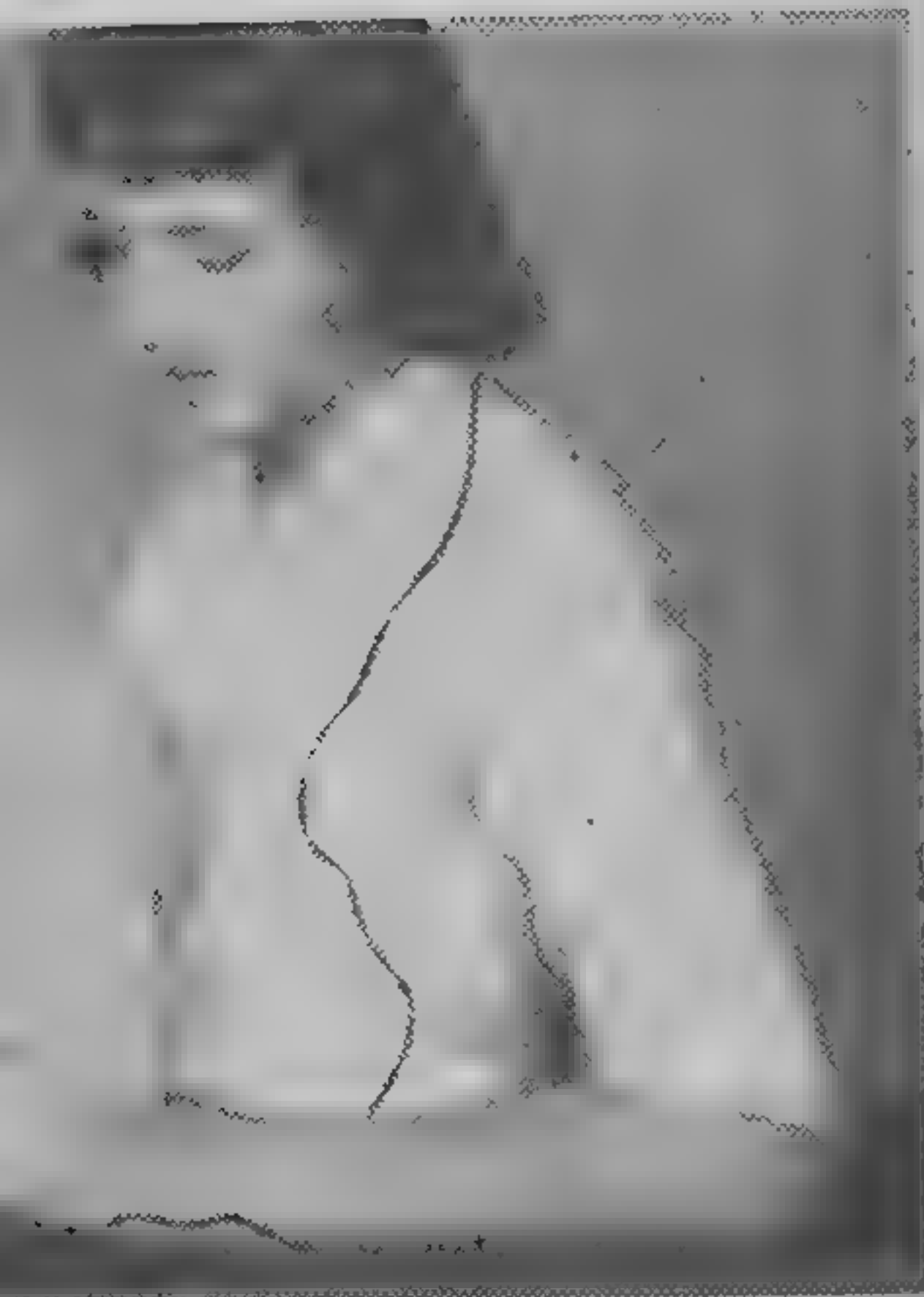
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received special recogni-
be considered a competent

cultural NEELY TURNER
Chief Entomologist

, in my opinion.
EPH H. KRAUS, Coordinator
National Science Fair

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well. Also, instead of gluing the
a wood screw (1 1/4 in. long)

about half way down and off to the side, thus
putting it on a pivot. This is handy when replac-
ing the three penlights.

Am almost finished with the wrist radio (from
the same issue). It's almost as much fun. How
about some small transistor radios?

16656 Monte Vista DEAN KENEALY
Detroit 21, Michigan

There'll be some, Dean. Keep watching.

South of the Border

Concerning the *Old Faithful Stinson* (June '59
S&M) I am already an owner of a Stinson Reliant
V-77 . . . I have heard that a number of these
have had a 450 hp Pratt & Whitney engine replace
the 300 Lycoming my plane now has . . . I find
this a good sound plane, but its climb perform-
ance seems slow. Is this engine change already
approved by FAA? I would appreciate any data,
since I have never been able to get any of the
specs on this plane.

Aeropuerto Las Piedras DAVID I. YEDER
Punto Fijo—Caja de Agua
Estado Falcon
Venezuela

*Sorry, but the FAA tells us no engine other
than the original has open approval for your ship.
Many V-77s (Army designation At-19) were made
for England in WW II and later sold as surplus,
some with the 450 as original equipment. But
agents privately suspect these were beefed up
some as compared with the lower horsepower
versions. They say the conversion would require
some hours of test flight for approval and might
prove quite costly. We think this big old gull-
wing, much heavier than the 108 Station Wagon,
never had a really fast climb, and some of the
slow climb you mention might have to do with
the temperatures and field altitudes at which you
operate.*

The Right Connections

Liked your article on 26 *Roadside Repairs*
(Aug. '59 S&M). However, if the coathanger cure
(page 168) is employed on cars using 12-volt
Delco Remy systems, the direct connection be-
tween the battery and coil will burn out the
points (unless the starter is being cranked). On
these units the jumper should go from the bat-
tery to the battery side of the resistor.

1311 W. 77th St. BILL GAYNOR
Chicago, Ill.

*Right you are, Bill. We should have added a
special note covering this.*

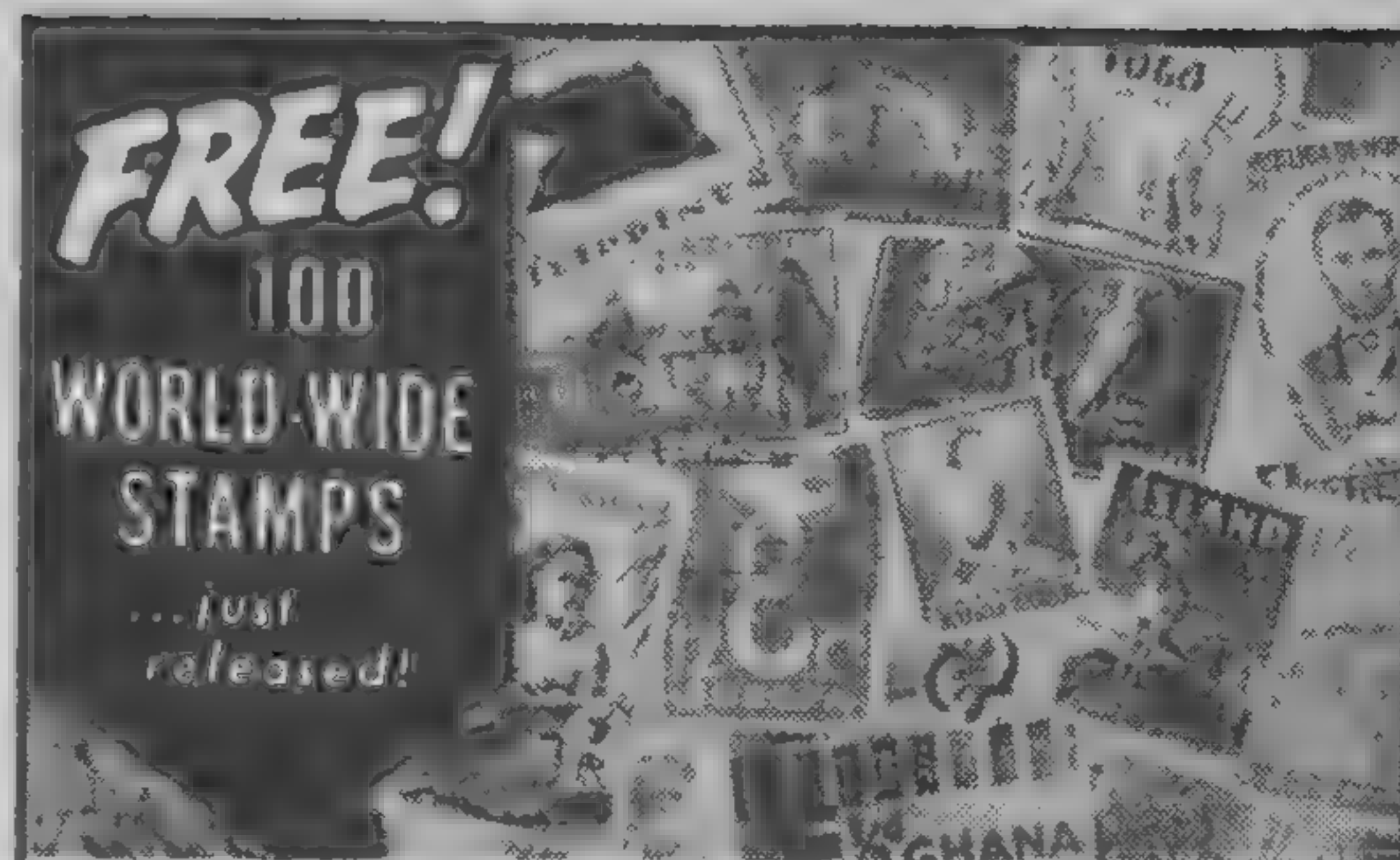
Sum Up S&M's?

If any reader is going to burn his S&M mags,
could he mind sending me the Cockpit Reports
and any aviation articles from them?

How about compiling a book of Cockpit Re-
ports for aviation bugs like myself? Maybe in-
clude a 3-view drawing of each?

Box 26 LARRY W. HOWETH
Alvarado, Texas

*How many Round Table members second Lar-
ry's motion?*



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Trial-and-Error Cycle?

The enclosed picture shows your powercycle (Craft Print 215) which has been my summer project. It took me quite a while to build it because I had to go by the trial-and-error method. I enjoyed building it and learned a lot from this project. I have a lot of fun riding it in the lot next door, and so do the neighbors.

Your magazine is so interesting and educational that I would like to get it every month.
224 N. Xenophon
Tulsa 7, Okla.

KENNY DAVIS

If the readers who now wait until the second month to purchase S & M would buy it a little sooner, Kenny, it would really help to get us going on an every-month basis.

Calling Madrigal

Your August article, *Making Instant Steel in Your Basement*, aroused my interest. I would like to get in touch with Mr. Frank Madrigal to find out more about his particular process.

Here in the Philippines steel is a very critical item. Our government is trying to put up a steel smelting plant. This "Madrigal Process," I believe, will be a great blessing to up and rising countries like the Philippines.

Squires Bingham Mfg. Co.

RAFAEL LAPUOS

328 San Vincente
Manila, Philippines

You can reach Frank Madrigal at the International Ore Processing Company, 10819 Vanowen, North Hollywood, California. And good luck in your efforts, Rafael.

Drive-Shaft Brakes

In your April '59 comparison tests on Plymouth, Ford and Chevrolet, you noted that the drive-shaft type parking brake on Plymouth was dangerous when used for stopping a moving car. Why?

269 Rochester Ave.
Brooklyn 13, N. Y.

M. GILBERT

Two things can happen when a parking brake is on the drive shaft. If the coefficient of friction is even, both rear wheels will lock and slide on braking. If one wheel is on a smoother surface than the other, the rear wheels will tend to rotate in opposite directions when parking brake is applied swiftly, so the drive shaft locks. This usually creates a violent oscillation of rear end, drive-shaft, and rear of engine, because the lightly mounted parts cannot cope with the uneven braking forces applied by the road to the tires.

He Fretted a Clock

I find the fretwork shown in your Feb. '52 issue (p. 12) very interesting. I have made a



number of fretwork articles—brackets, boats and several different clocks, including the one shown in the enclosed photo I made 50 years ago.

413 Columbus Ave.

W. C. FOERSTER

Batesville, Ind.

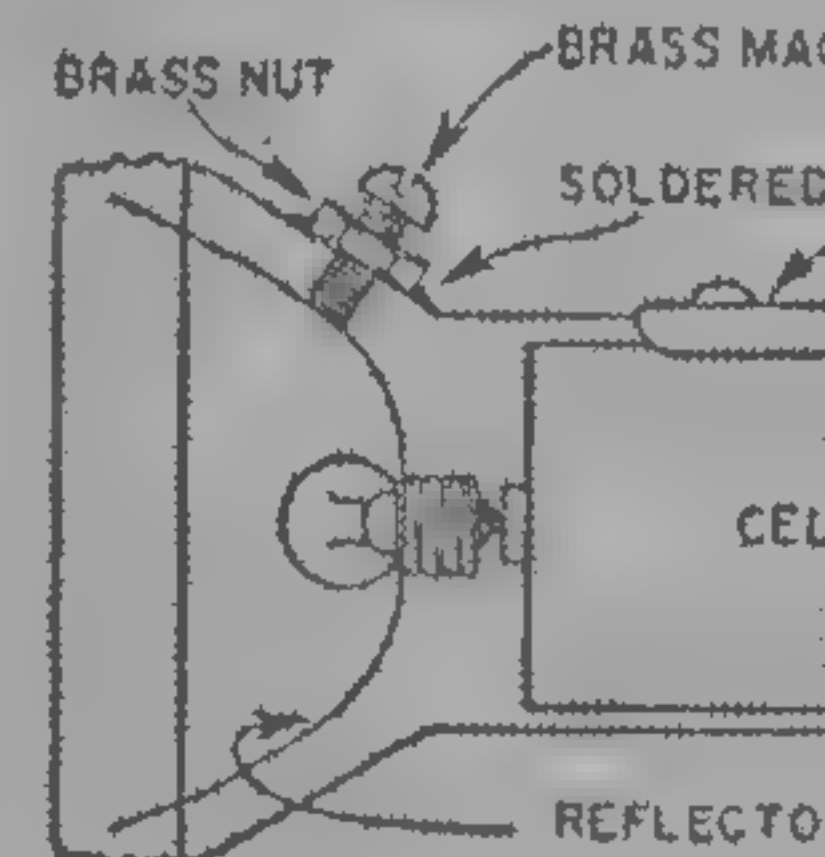
If we ever tried to do such an intricate job, it would take us a good 50 years to complete it. Nice work, Reader Foerster.



Kinks

Salvaging

• Since a flashlight's lens and the interior of the reflector are made of brass, repairs, it is simpler to replace the entire unit when it is broken than to install a simple substitute.



drilling a hole in the reflector, then soldering a square or round nut and twisting a roundhitch nut. To light the lamp, turn the reflector clockwise until the end of the reflector. This provides a seal from the case to the lens, usually in contact with the lens. To turn off the lamp, turn the reflector counter-clockwise until the end of the reflector is in contact with the lens.

If you do it yourself and want a copy of the 1960 edition (Vol. 2, No. 564). Contact Science and Mechanics, That Shows You How to Make Things, contains tested tips and shortcuts.

Get your copy of the SCIENCE AND MECHANICS

JANUARY, 1960

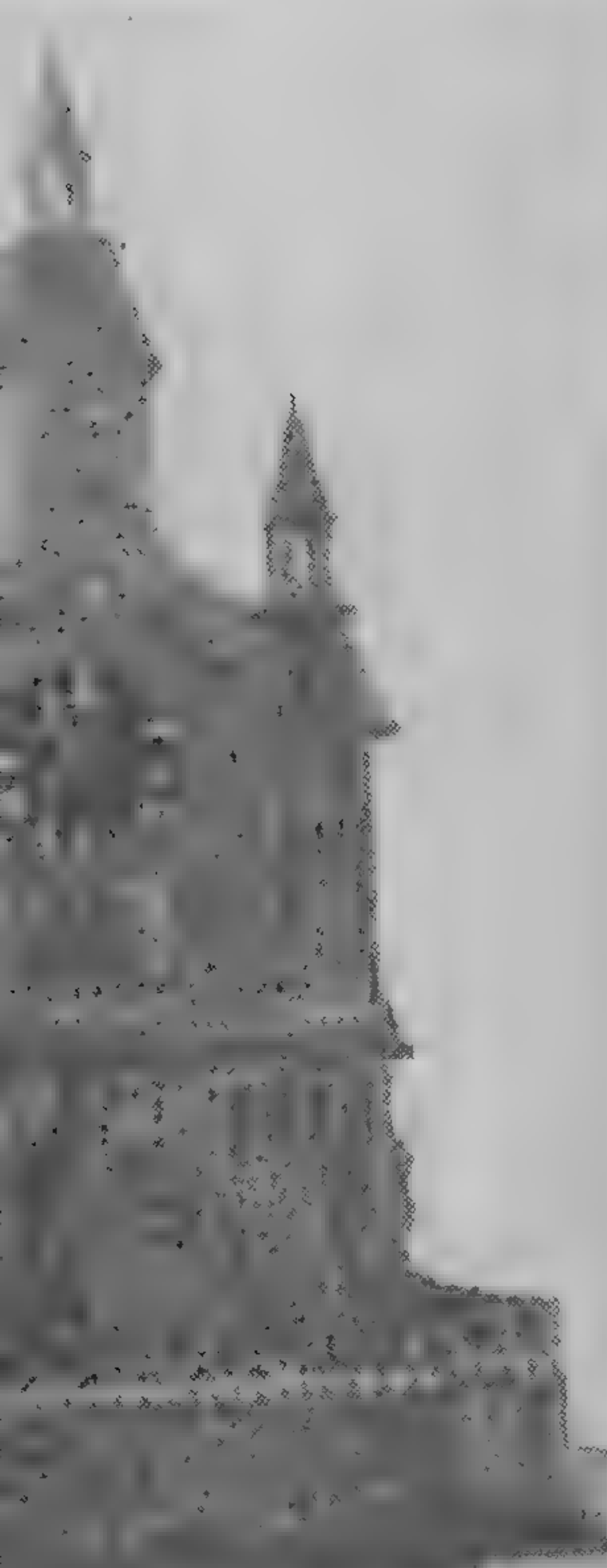
SCIENCE AND MECHANICS

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M. GILBERT

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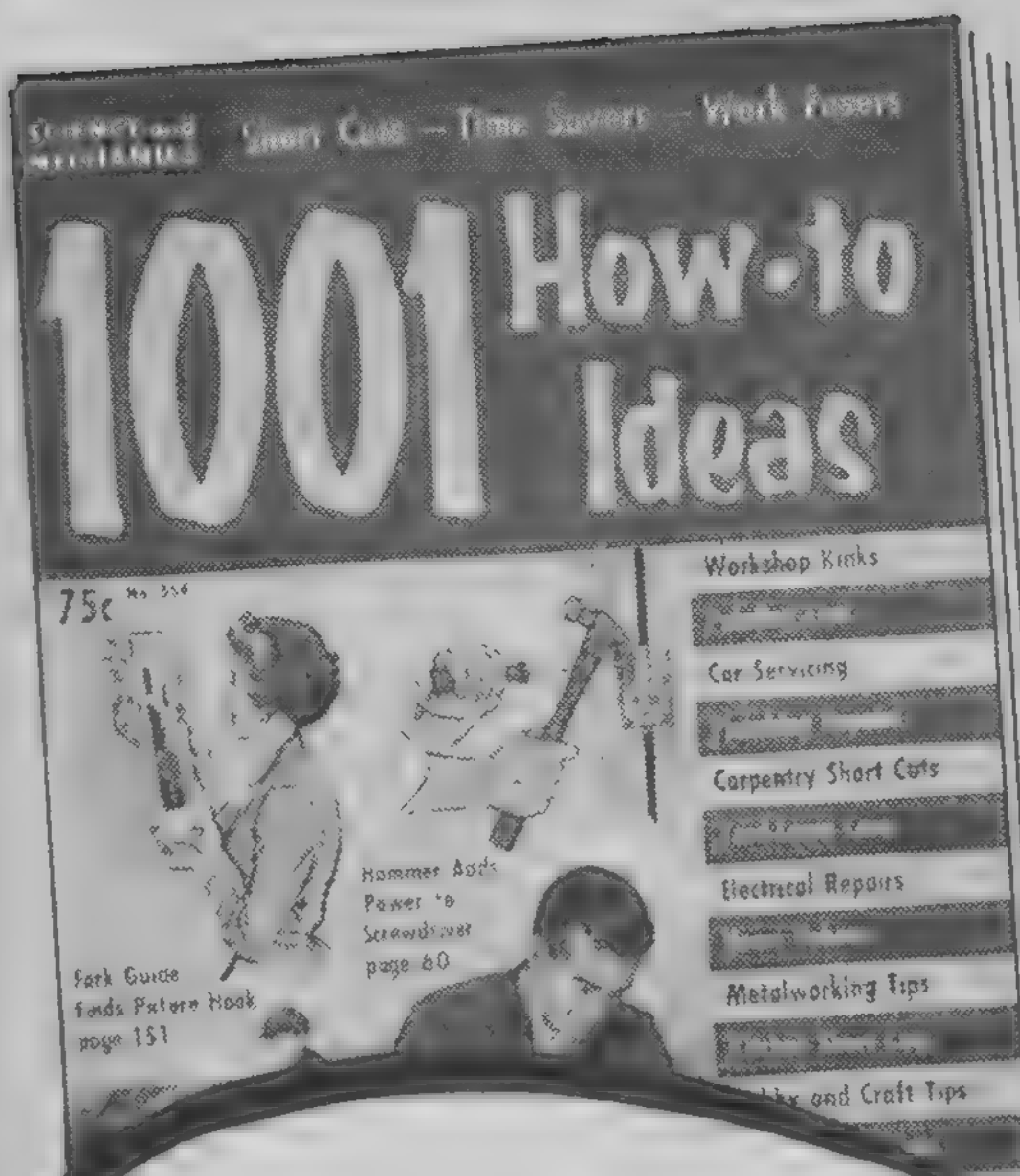


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W. C. FOERSTER

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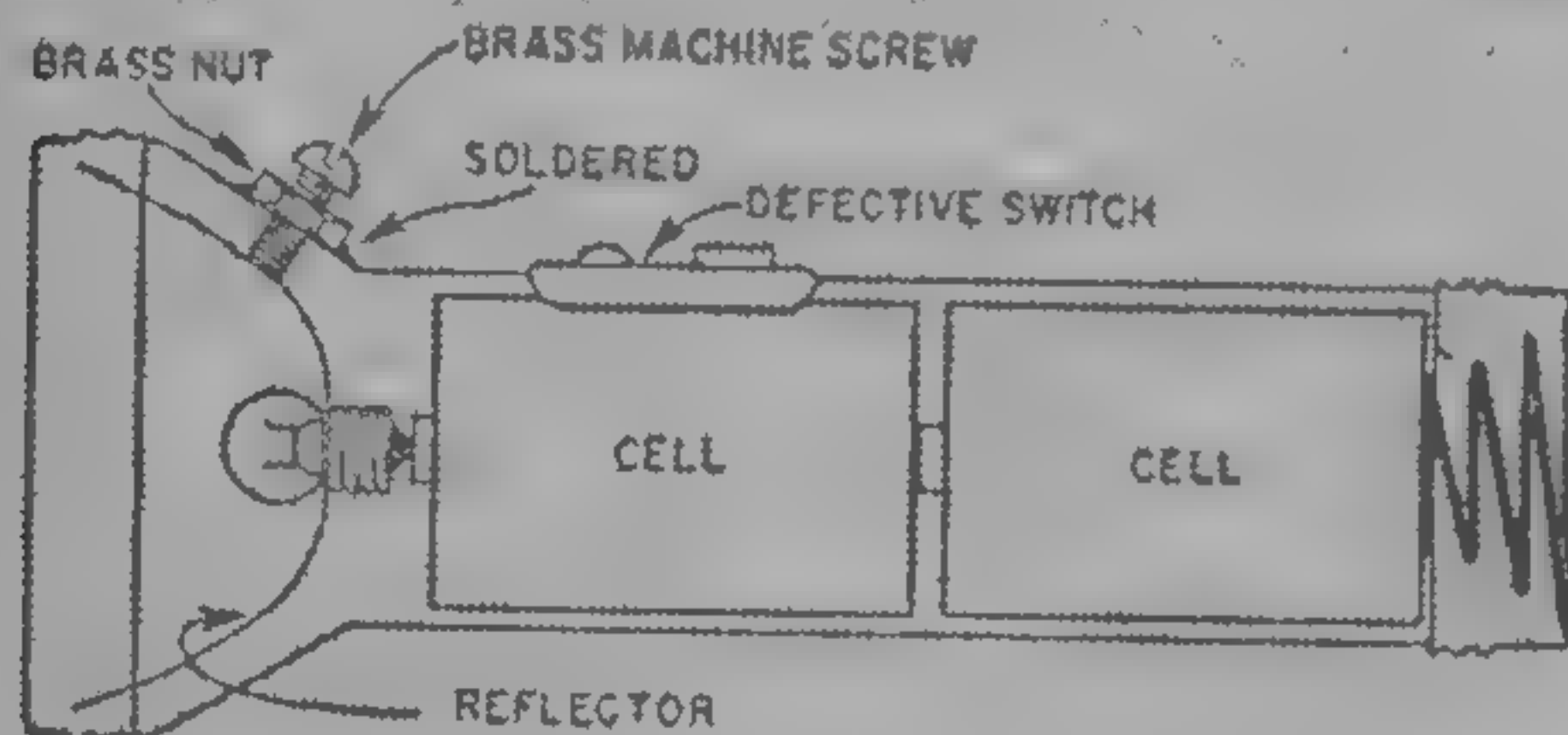
SCIENCE AND MECHANICS



Kinks like this

Salvaging Flashlights

• Since a flashlight switch is riveted to the case, and the interior of the case is hard to get at for repairs, it is simpler to ignore the original switch entirely when it is broken or badly worn and install a simple substitute switch. Do this by



drilling a hole in the case close to the reflector, soldering a square or hexagon nut over the hole, and twisting a roundhead machine screw into the nut. To light the lamp, simply turn the screw clockwise until the end of the screw contacts the reflector. This provides the necessary connection from the case to the reflector, as the reflector is usually in contact with the lamp base but not the case. To turn off the lamp, back up the screw.

If you do it yourself around the home, you'll want a copy of the 1960 edition of *1001 How-to Ideas* (Vol. 2, No. 564). Compiled by the editors of *Science and Mechanics Magazine*—The Magazine That Shows You How—*1001 How-to Ideas* contains tested tips and shortcuts that will save you

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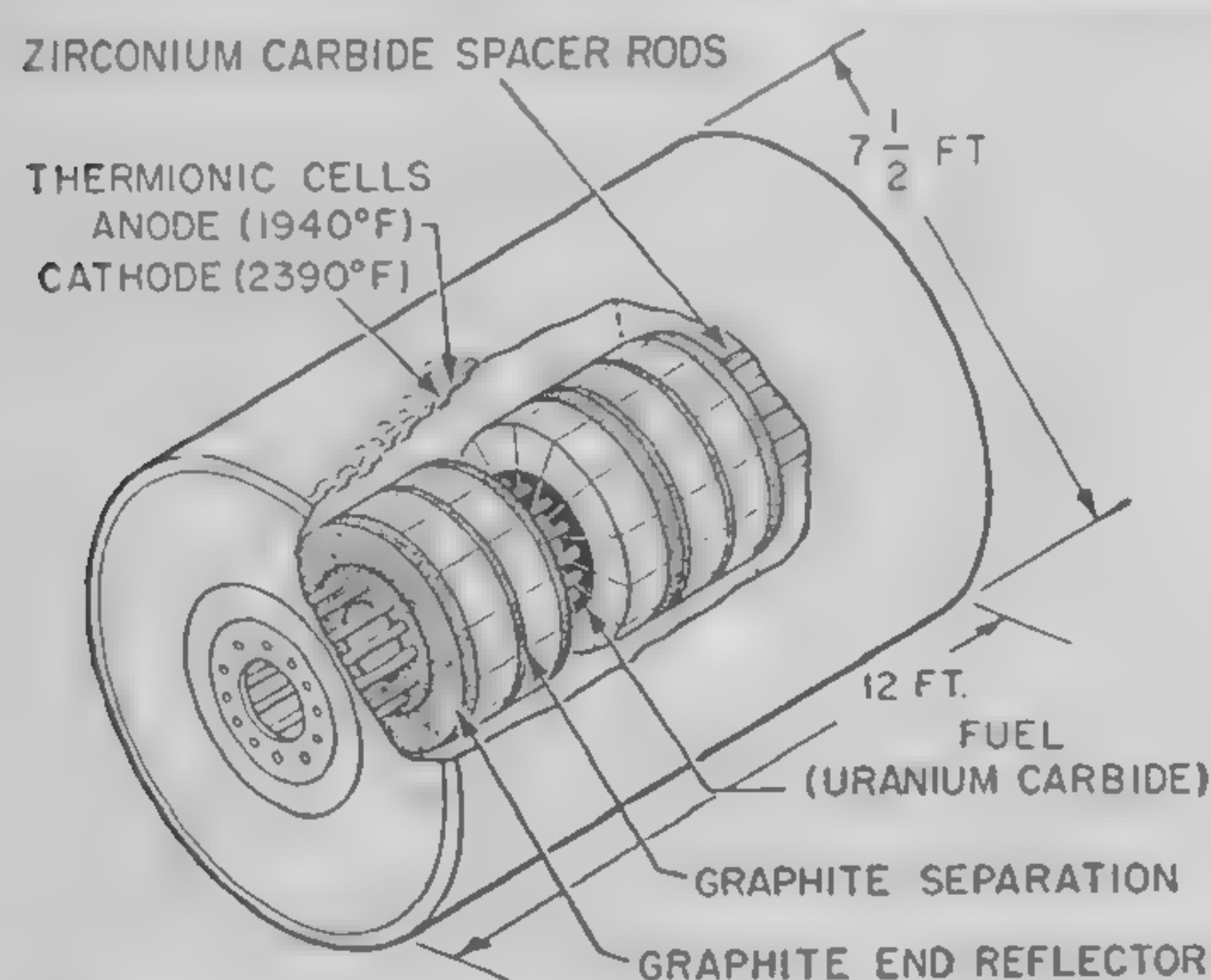
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JANUARY, 1960

Science Briefs

A nuclear reactor—towed on a mile-long cable—would convert atomic power directly into electrical energy to run an ion-propelled space-craft through the gravity-free void of outer space. The low-thrust system, proposed by scientists at Lockheed Missiles and Space Division, Sunnyvale, Calif., would be used only after the vehicle and reactor were boosted into space by a large chemical



rocket. Schematic drawing shows how heat from reactor would "boil" electrons off cathode. Electrons would then "condense" on the cooler anode, producing electrical current which would run through the cable (a mile long to protect the ship from the reactor's radiation) to ionic propulsion system. Total power yield of the 200 thermionic cells arrayed around the outer cylinder would be 1000 kilowatts, enough to power the spacecraft for a year, says Lockheed.

▼ ▼ ▼

Night driving lenses and windshields actually make seeing at night more difficult. The Committee on Industrial Ophthalmology of the American Medical Association's Council on Industrial Health says the source of night driving glare is the contrast between the headlights of oncoming cars and the darker surroundings. This contrast is not reduced by night driving lenses or windshields—whether tinted, reflecting or polarizing—which actually reduce the light transmitted to the eye, impairing vision.

▼ ▼ ▼

Either a new galaxy is forming or two Chicago astronomers have spotted the wreckage left after the collision of two galaxies. These are possible explanations of a "remarkable extragalactic sys-

tem" found on plates taken with the 82-inch telescope at Fort Davis, Tex., by Drs. E. Margaret and G. R. Burbidge, a husband and wife team working at the Yerkes and McDonald Observatories of the University of Chicago. The system consists of numerous large patches of light, embedded in a luminous haze.

▼ ▼ ▼

Want to sleep better? Then it might be a good idea to throw away your sleeping pills and get a loudly ticking alarm clock. Psychologist R. C. Davis of Indiana University says his research indicates we relax better when subjected to a little noise and light than when we're in quiet darkness. The reason? Davis thinks that when we're in the dark, we are always expecting something to happen, thus are less relaxed.

▼ ▼ ▼

Newly developed plastic bubbles used to protect airplane and rocket instruments are worth more than their weight in gold. The protective material consists of microscopic plastic balloons of phenolic resins bound together by another plastic epoxy resin. It saves more than a quarter in weight over conventional filler materials. Since reduction of a pound of weight in airplane equipment is estimated to save \$765, the bubbles are worth more than gold, which is \$420 a pound. The bubbles were developed by F. T. Parr of Westinghouse Electric Co., Pittsburgh, Pa.

▼ ▼ ▼

Heavier payloads, more thrust at take-off and longer jet engine life should result from new airplane fuels that burn less brightly. Secret of the fuels, which were developed by Texaco, Inc., of New York City, is their high LN—a number expressing luminosity of the combustion flame. Most present jet fuels have an LN of from 45 to 65, while the new fuels are rated upward from 135. In combustion, the high LN fuels form fewer

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The "Edu-Kit" offers a rock-bottom price. Our K... use of the most modern n... tion practice and servicin... You will learn how to... in a professional manner; punched metal chassis as... You will learn the basi... RF and AF amplifiers and... and practice code, using... trouble-shooting, using the... sive Dynamic Radio & E... You will receive training... Amateur Licenses. You wil... and Signal Injector circuit... background for Television... Absolutely no previous l... product of many years of... vide you with a basic educ... price of \$22.95. The Sign...

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You do not need the slig... in radio or science. Whethe... ested in Radio & Electron... want an interesting hobby... business or a job with a fut... the "Edu-Kit" a worth-w... Many thousands of inc...

PROGR... The Progressive Radio '... and is universally accepted... Kit' uses the modern educ... learn schematics, study the... gram designed to provide a... You begin by examining... function, theory and wiring... set you will enjoy listenin... and trouble-shooting. Then... and techniques. Gradually... find yourself constructing n... professional Radio Technici... Included in the "Edu-Kit" Signal Tracer, and Signal... experiments, but genuine... and soldering on metal ch... "Printed Circuitry." These...

THE
You will receive all parts... tronica circuits, each guaran... electrolytic, mica, ceramic... hardware, tubing, punched... In addition, you receive... special tube sockets, hardwa... professional electric solderi... Tester. The "Edu-Kit" also... in addition to F.C.C.-type Q... will also receive lessons for... sive Signal Injector, a High... Radio-TV Club, Free Consu... You receive all parts, tools...

Unconditional Money-B...

The Progressive Radio "E... sold to many thousands of in... and organizations, public and... out the world. It is recogniz... as the ideal radio course... By popular demand, the... "Edu-Kit" is now availabl... well as English.

It is understood and ag... the Progressive Radio "E... turned to Progressive "Edu-... reason whatever, the purch... refunded in full, without... tion, and without delay.

The high recognition w... "Edu-Kits" Inc. has earned... years of service to the pub... unconditional insistence up... nance of perfect engineering... structional standards, and... to its Unconditional Money... As a result, we do not have... fied customer throughout t...

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BUILD 16 RADIO

CIRCUITS AT HOME

with the New Deluxe
PROGRESSIVE RADIO "EDU-KIT"

A Practical Home Radio Course

Now Includes
★ TRANSMITTER
★ SIGNAL TRACER
★ SIGNAL INJECTOR
★ CODE OSCILLATOR

★ No Knowledge of Radio Necessary
★ No Additional Parts or Tools Needed
★ EXCELLENT BACKGROUND FOR TV
★ School Inquiries Invited
★ Sold in 79 Countries

ONLY
\$22⁹⁵



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Pat. Off.

YOU DON'T HAVE TO SPEND
HUNDREDS OF DOLLARS FOR A RADIO COURSE

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL. You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis. You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester and the accompanying instructional material. You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build 16 Receiver, Transmitter, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for Television, Hi-Fi and Electronics. Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the complete price of \$22.95. The Signal Tracer alone is worth more than the price of the entire Kit.

THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment. Many thousands of individuals of all

ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble-shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio. You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are sixteen Receiver, Transmitter, Code Oscillator, Signal Tracer, and Signal Injector circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build 16 different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, coils, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, etc. In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

Unconditional Money-Back Guarantee

The Progressive Radio "Edu-Kit" has been sold to many thousands of individuals, schools and organizations, public and private, throughout the world. It is recognized internationally as the ideal radio course.

By popular demand, the Progressive Radio "Edu-Kit" is now available in Spanish as well as English.

It is understood and agreed that should the Progressive Radio "Edu-Kit" be returned to Progressive "Edu-Kits" Inc. for any reason whatever, the purchase price will be refunded in full, without quibble or question, and without delay.

The high recognition which Progressive "Edu-Kits" Inc. has earned through its many years of service to the public is due to its unconditional insistence upon the maintenance of perfect engineering, the highest instructional standards, and 100% adherence to its Unconditional Money-Back Guarantee. As a result, we do not have a single dissatisfied customer throughout the entire world.

FREE EXTRAS

• SET OF TOOLS

- SOLDERING IRON
- ELECTRONICS TESTER
- PLIERS-CUTTERS
- ALIGNMENT TOOL
- WRENCH SET
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of troubles in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

J. Statatilis, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" paid for itself. I was ready to spend \$240 for a Course, but I found your ad and sent for your Kit."

FROM OUR MAIL BAG

Ben Valerio, P. O. Box 21, Bama, Utah: "The Edu-Kits are wonderful. Here I am sending you the questions and also the answers for them. I have been in Radio for the last seven years, but like to work with Radio Kits, and like to build Radio Testing Equipment. I enjoyed every minute I worked with the different kits; the Signal Tracer works fine. Also like to let you know that I feel proud of becoming a member of your Radio-TV Club."

Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Troubleshooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

ORDER DIRECT FROM AD—RECEIVE FREE BONUS RESISTOR AND CONDENSER KITS WORTH \$1

- ☐ Send "Edu-Kit" postpaid. I enclose full payment of \$22.95.
- ☐ Send "Edu-Kit" C.O.D. I will pay \$22.95 plus postage.
- ☐ Send me FREE additional information describing "Edu-Kit."

Name

Address

PROGRESSIVE "EDU-KITS" INC.

Progressive Building, Dept. 559C, 1184-86 Broadway, Hewlett, N. Y.

incandescent molecular fragments than present fuels—fragments that can seriously increase temperatures inside an engine without adding power.

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A heap of pea-sized pellets could lead to sharp cuts in production and maintenance costs of atomic power reactors. Used in a startling new reactor system—called a liquid fluidized bed reactor—the pellets would end the need for complex control rod equipment, would cut fuel fabrication costs and would make it easier to recover valuable fissionable material from the reactor core after use.

The pellets, containing fissionable fuel, would be immersed in liquid inside a large, upright cylinder. Because a power-producing chain reaction would take place only when the pellets are separated from each other, the reactor would be turned on simply by forcing more liquid up through the cylinder bottom (see drawing). Reduce the flow rate, and the gaps between the pellets would disappear and the chain reaction would stop. The system is being developed for the Atomic Energy Commission by the Nuclear Division of the Martin Co., Baltimore, Md.

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Suffering from "television bottom?" Many Americans are, says Dr. Wilford L. Cooper of Lexington, Ky. The medical term for the condition is coccygodynia, or pain in the tail of the spine. It arises frequently from spending long periods of time in front of the TV. Dr. Cooper, who says women are more susceptible than men, also blames long auto drives for many of the pains.

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When Junior has the mumps, keep Fido away from him or he may catch them too. Two cases of mumps in dogs were recently reported, although the transmission of the disease in animals other than man or monkeys is extremely rare, report members of the veterinary science department, North Dakota Agricultural College, Fargo.

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First proof that burning helium accounts for the heat and light in red giant stars comes from Dr. David E. Alburger, a physicist with Brookhaven National Laboratory, Upton, N. Y. Dr. Alburger's findings verify a theory of British physi-

cist Fred Hoyle, who suggested in 1954 that after a star's hydrogen has burned, producing helium, the helium then burns itself into carbon. The new finding provides an important link in the chain of reactions by which heavy elements are built up from light ones.

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Travel to the moon and to the limits of the solar system will be possible in five to 20 years, predicts a National Aeronautics and Space Administration scientist. John C. Evvard sees a round trip to Mars taking 1205 days—with 246 days allowed for exploration of the planet. Power plants of combined nuclear and electrical sources that will do the trick are now under study, he says.

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Water that comes out of faucets in Madison, Wis., fell as rain 2000 years ago. The city's deep wells tap water-bearing sandstone formations that slope up to the north and west to outcroppings centered about 120 miles from the city. Water falling on the outcrop seeps through the rock at a rate of about a third of an inch an hour, says Elmer L. Nordness, the city's water superintendent.

▼ ▼ ▼

Do you have blue eyes? If so, you're lucky, because you feel pain from a dental drill less than your brown or dark-brown-eyed neighbor. So says Philip R. N. Sutton of the dental school at the University of Melbourne, Australia. Of the 403 dental patients Sutton examined, 13% of those with grayish-green, green or hazel eyes asked for a pain reliever—compared to 30% of the patients with light brown or brown eyes and 53% of those with dark brown eyes.

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A tiny plastic tube, smaller than a pencil point, can restore hearing to nine out of 10 people who are deaf because of formation of spongy bone in their middle ear. This condition, called otosclerosis, locks the ear mechanisms so rigidly they cannot vibrate to transmit sounds. More than 1,000,000 persons in the U. S. are deaf because of it. In an operation developed by Dr. Alan A. Scheer of the New York University College of Medicine, a surgeon makes an incision in the ear canal, folds back half the ear drum, loosens the hardened internal workings of the ear and tucks the almost invisible tube in as a replacement for one of the malfunctioning ear bones.

▼ ▼ ▼

Women who smoke while they're pregnant have babies that average 6 ounces lighter than those born to non-smokers, according to a study made by Dr. C. R. Lowe, of England's University of Birmingham. Reason: tobacco has a drug-like effect on the unborn child and restricts the mother's blood circulation.

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For 12 m

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Many men have d
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Trained meat men needed. Good
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NATIONAL SCHOOL OF MEAT

Dept. 53-V

Tele

FEBRUARY, 1960

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Not everyone does as well, but T. N. Cony, who started a business of his own, reports...

For 12 months I've averaged

\$800 PER MONTH INCOME

—most of it clear profit for me!

Many men have discovered how to be independent, to be free of layoffs and bosses. C. G. Naples grossed more than \$200 his first week. A father-son combination grossed \$44,000 their second year. H. Lemon says, "I netted \$133 in one 8-hour day."

How much you make depends largely on you. You need no special skill, no large investment. Start part time if you wish.

NO SHOP NECESSARY • Our Electric Deterger shampoos rugs, carpets right on floor—removes dirt and grime and helps to show their natural color and beauty. So efficient and safe it is used by largest railroads and hotels.

► **This is not a lease proposition. You own the machine, you work when and where you please and all the money you take in is your own. You take no risk. Machines fully guaranteed.**



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Get your training under actual meat market conditions in our big modern cutting and processing rooms and retail meat market. Expert instructors show you then you do each job yourself. Nearly a million pounds worth of meat is cut, processed, displayed and merchandised by National students yearly!

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Come to National for complete 8-weeks course and pay your tuition in easy installments after you graduate. **G. I. APPROVED.** Diploma awarded. Free employment help. Thousands of successful graduates. **OUR 37th YEAR!**

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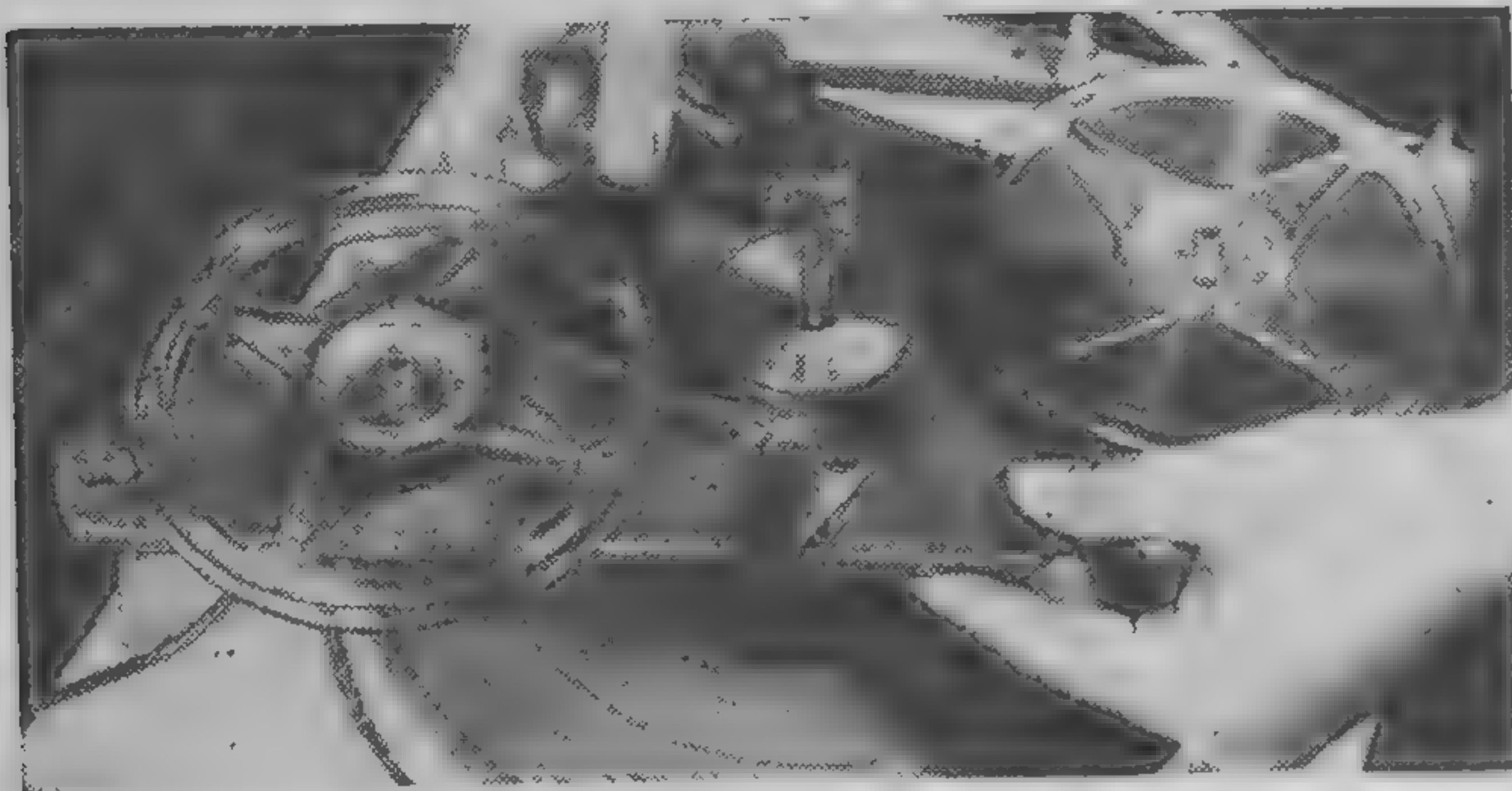
NATIONAL SCHOOL OF MEAT CUTTING, INC., Dept. 53-V, Toledo 4, O. Send me **FREE** school catalog on **LEARN-BY-DOING** training in **PROFITABLE MEAT CUTTING, SUCCESSFUL MEAT MERCHANDISING and SELF-SERVICE MEATS** at Toledo. No obligation. No salesman will call. **Approved for Veterans.**

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WHAT'S NEW



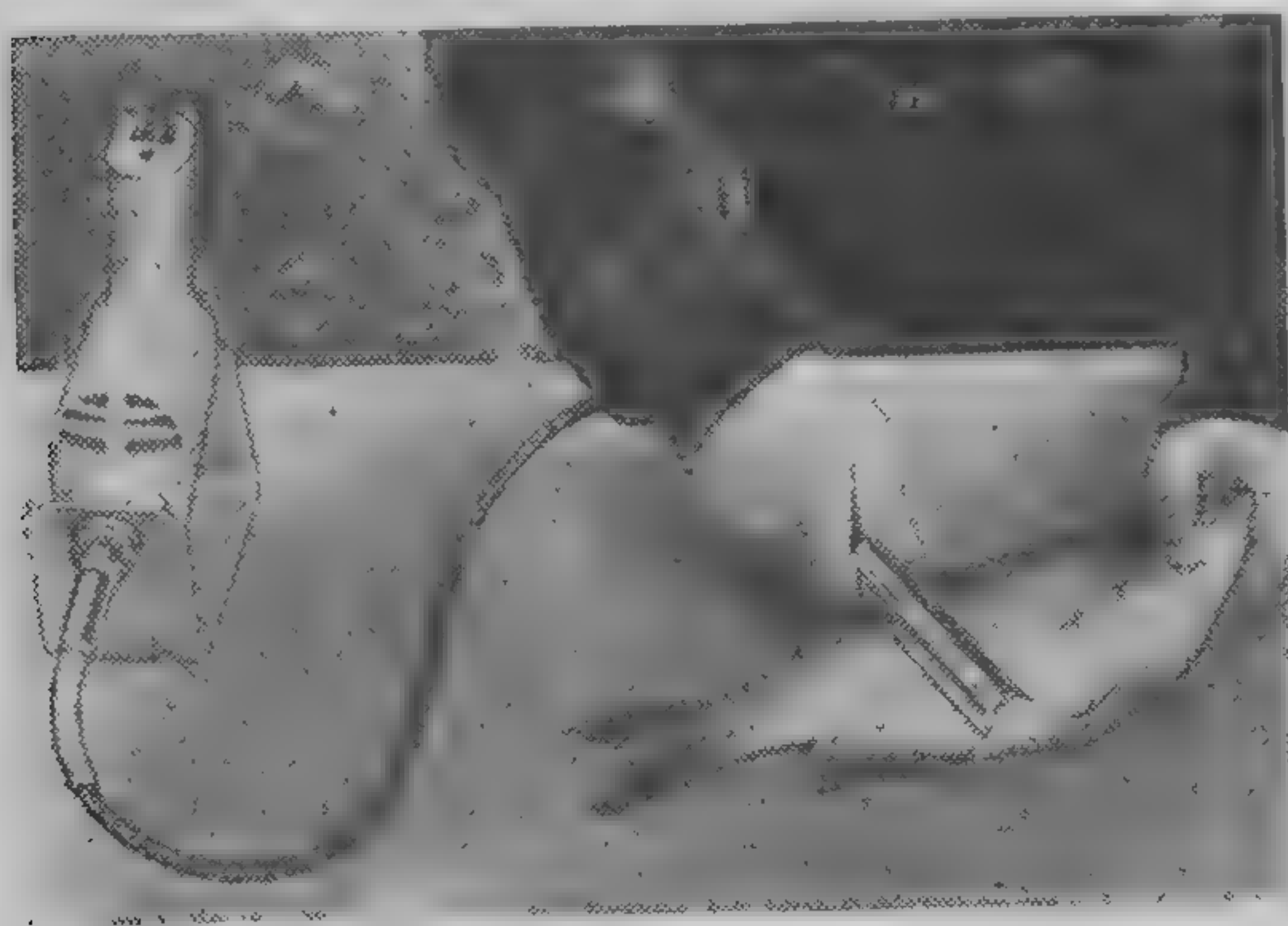
Add a Tape Recorder to Your Phono

• With the *Gramdeck* you can turn your phono into a tape recorder—or back into a phono—within a few seconds. The Gramdeck just slips onto the turntable as easily as a record; the turntable drives the tape spools and the phono loudspeakers provide sound reproduction. A pre-amp/control unit which uses transistors and printed circuits and which is installed permanently on the phono in a few seconds, is part of the kit.

Standard tapes are used, and the erase-head clears them for re-use. The imported tape recorder with control unit and five-inch take-up reel is priced at \$49.75. Complete with a moving coil microphone, the Gramdeck costs \$62.25, according to the distributor, Andrew Merryfield of Canada Ltd., Import Div., 265 Adelaide St., W., Toronto 1, Canada.

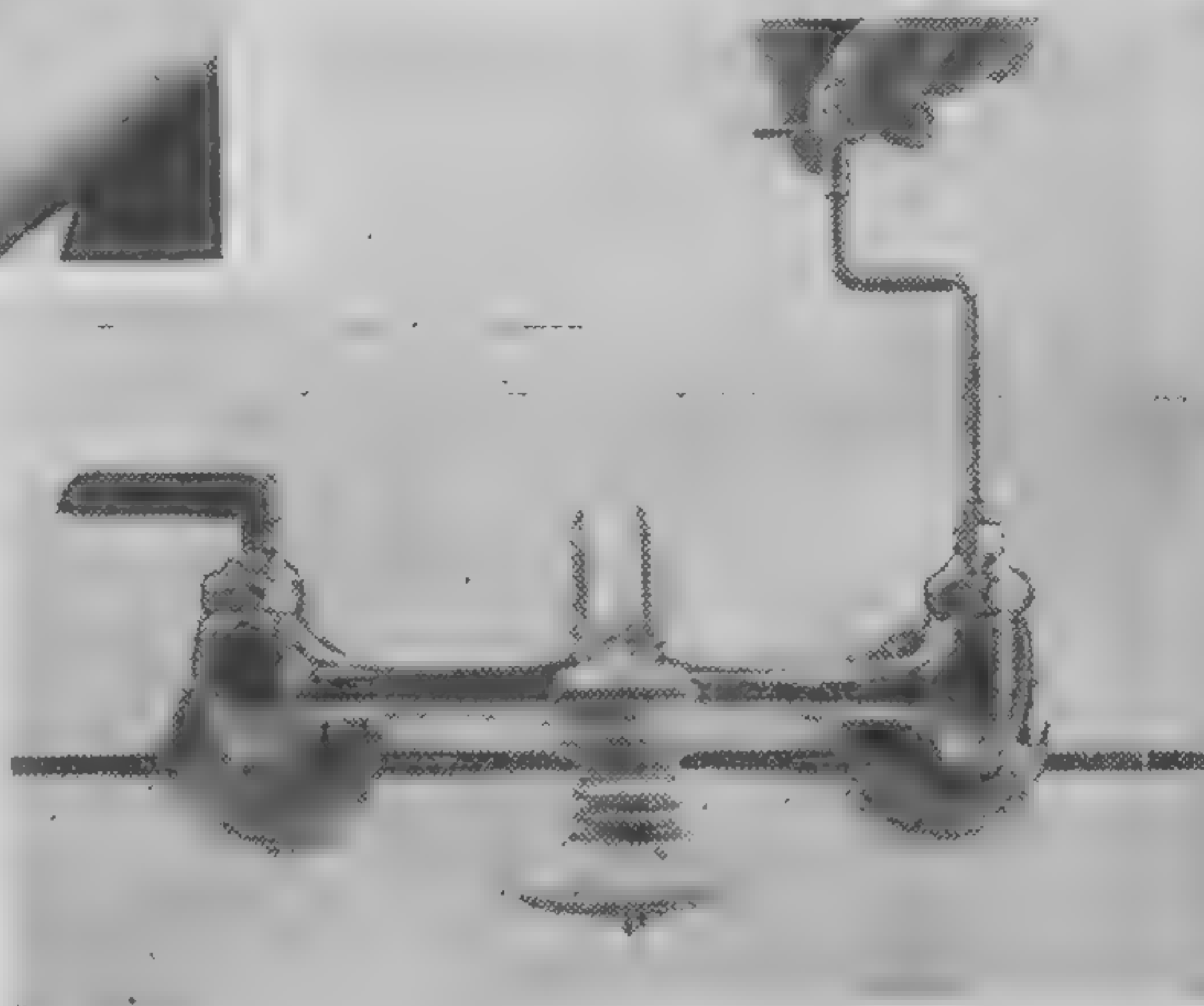
Fish Scaling Attachment for Your Drill

• The sportsman in the photo is scaling a fish—but his electric drill is furnishing the power. The rotating scaler is at one end of a 30-in.



flexible shaft, the other end, fitted with an adapter, being chucked in the portable drill. Tidy work is ensured by a guard that keeps the scales from flying.

The \$13.95 kit also contains a buffing wheel and two emery wheels for cleaning and polishing fishing tackle and for sharpening hooks and knives. The manufacturer, the Dremel Mfg. Co., Dept. WED, Racine, Wisconsin, says a deluxe scaler with an attached motor is available at \$29.95.

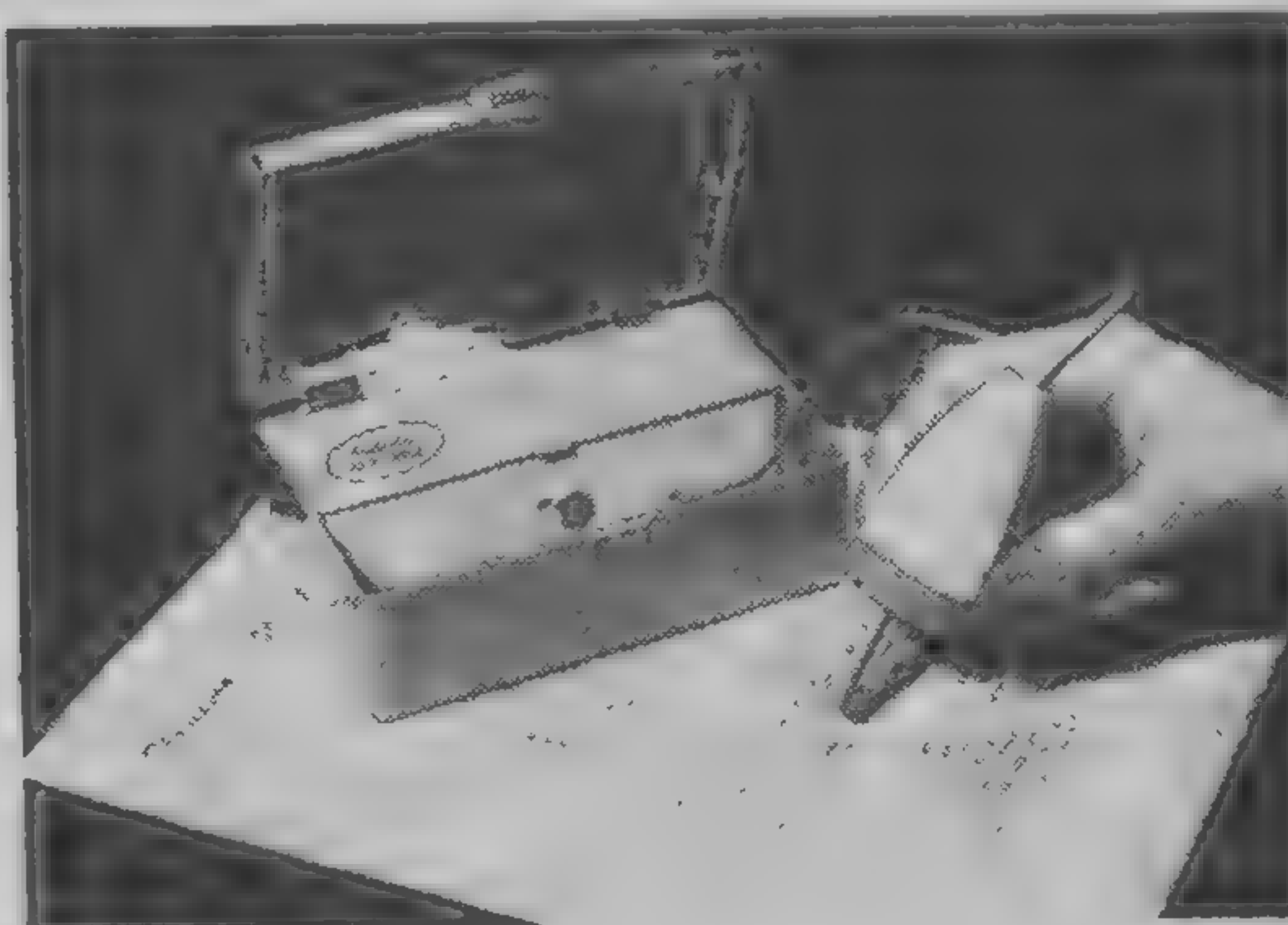


Faucet Seat Refacer

• Leaky and pitted water faucets forsake their drippy ways if their innards are squared up and smooth. This \$1.95 tool is said to produce that result for even the most amateurish home plumber. The manufacturer, O. Olson & Co., P. O. Box 43194-SM, Los Angeles 43, Calif., says there is no risk of harming the faucet.

Battery-Driven Eraser

• Because of the speedy rotation of this power-driven eraser, pressure is not needed to produce neat erasures. Therefore it is unnecessary to shield carbon copies. Ink and pencil replacements are available at stationery stores. Priced



Can You BETTER BIGGER

or do you
for the job

Use Your
at Home
for YOUR

FULL INFO

Yes, what about you? Are you getting into a rather hazy and distant future? Can you do is hope for the future? Or, can you look into the future? Or, can you look into the future...knowing you have the power to make you capable of producing the future?

U. S. Government statistics show that school graduates earn an average of \$100 per week than people with no education...this proves the value of a school diploma. But even with a school diploma, job competition is tough. And if it's time for you to decide, don't know which way to go, you can cope with that situation in a year alone, over half a million people are doing it.

AMERICAN
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The sooner
you ACT,
the sooner
YOUR GOAL
can be
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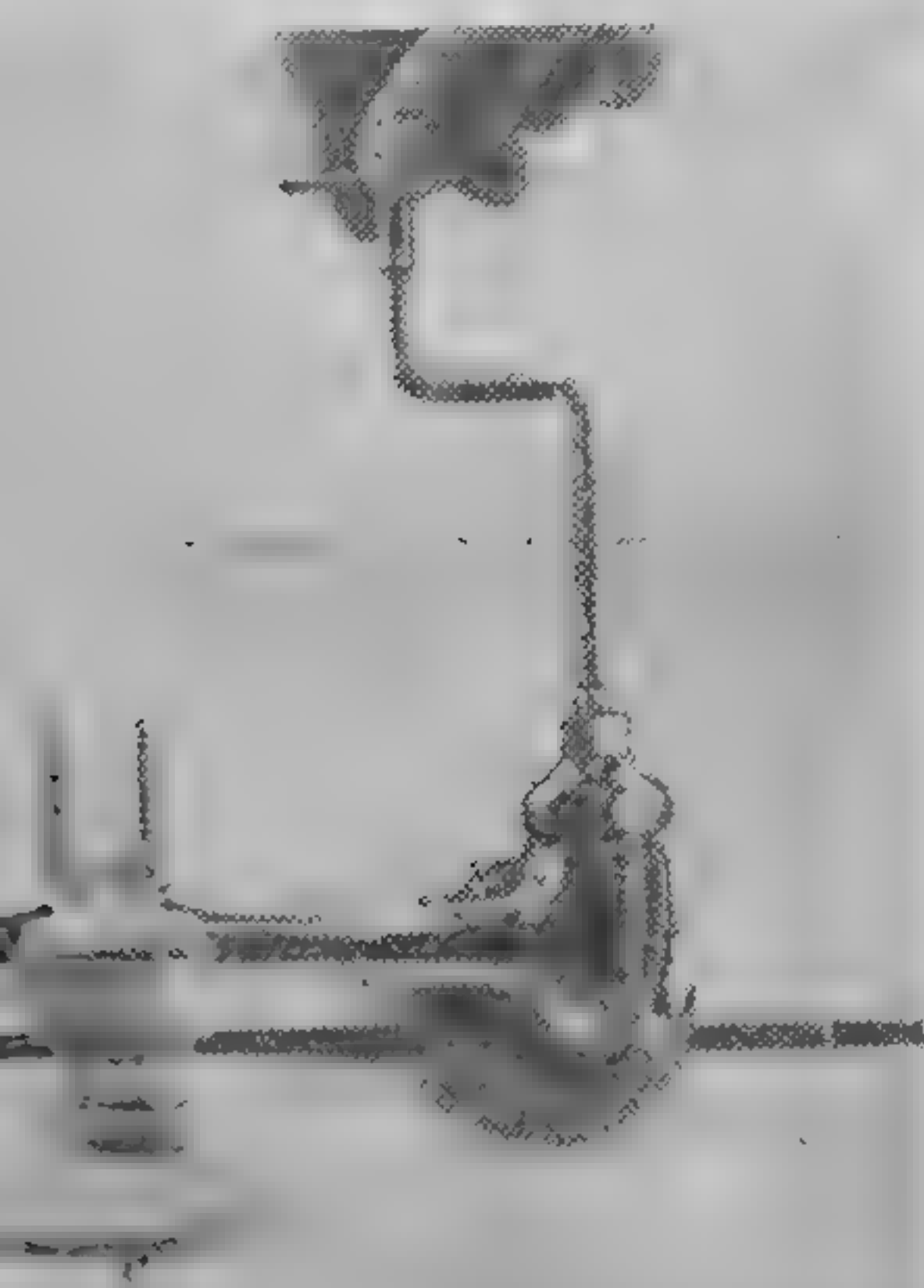
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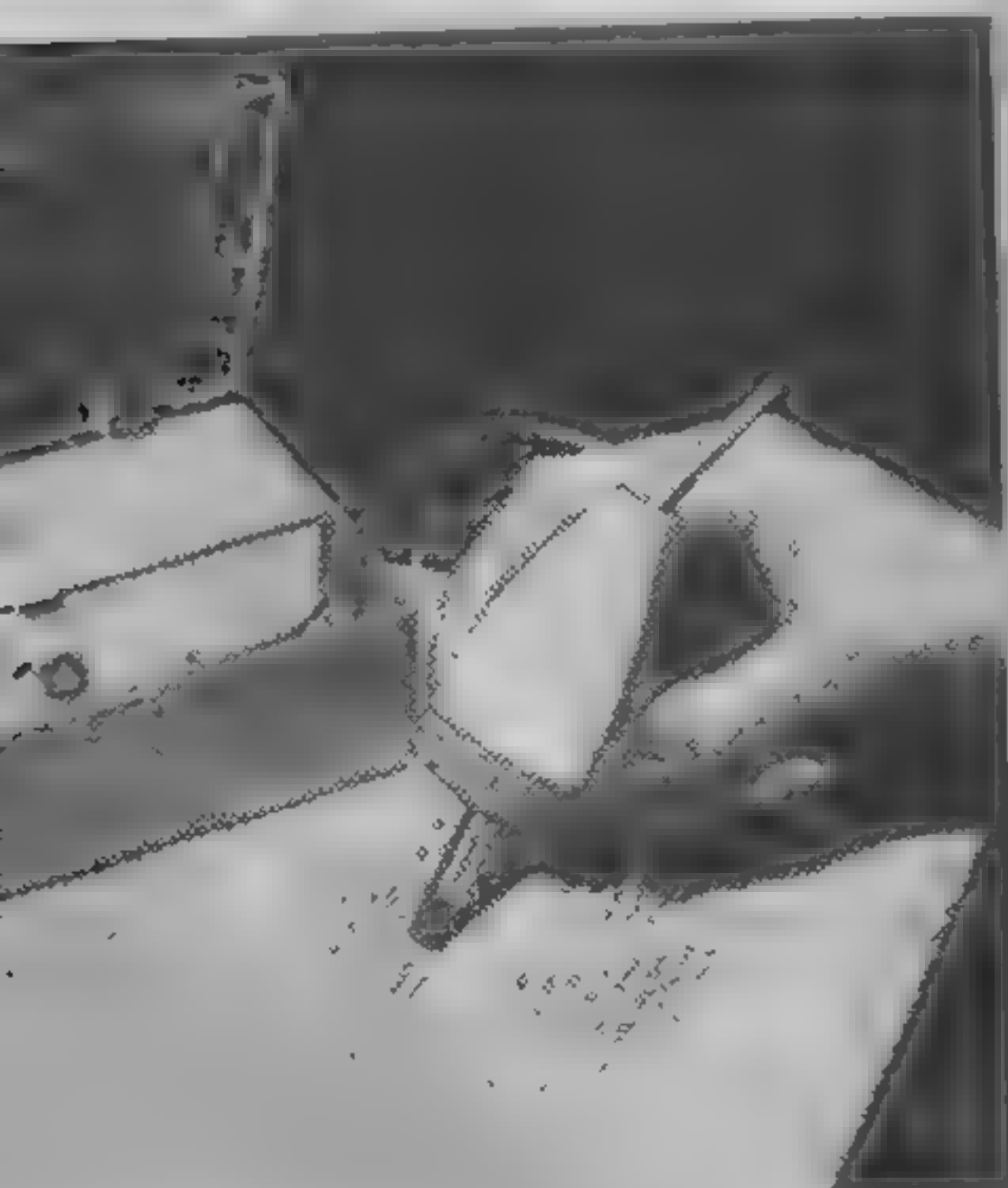


Seat Refacer

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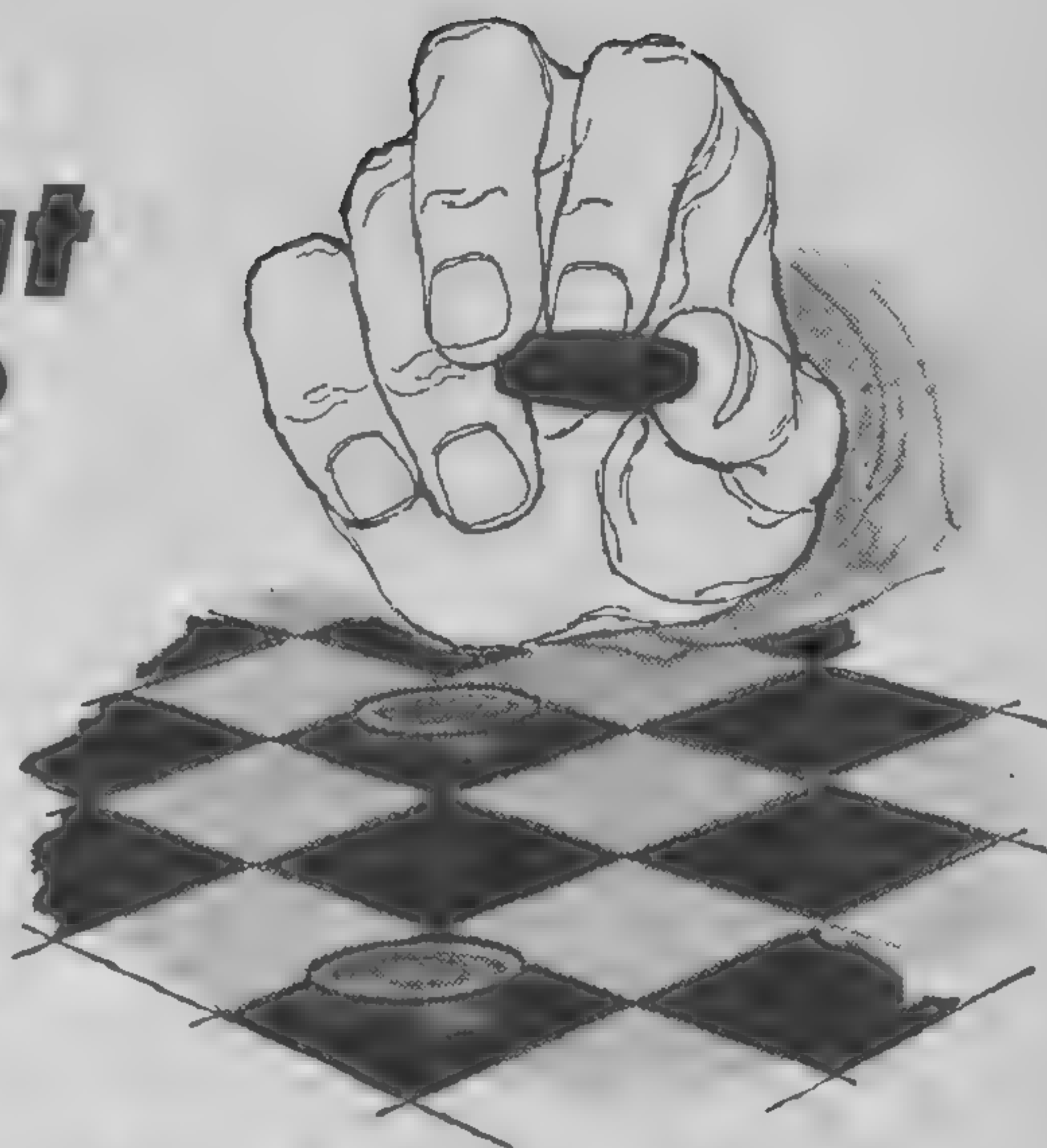
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for the job you want?

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at Home and Prepare
for YOUR CAREER!**



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Yes, what about your future? Do you look into a rather hazy and distant time when all you can do is hope for the promotion or job you want? Or, can you look into the future with confidence...knowing you have the training which makes you capable of progress?

U. S. Government statistics show that high school graduates earn an average of \$38 more per week than people with only a grade school education...this proves the importance of a high school diploma. But even with a high school education, job competition today is extremely tough. And if it's time for your move...and you don't know which way to go...you can't expect to cope with that situation. That is why, last year alone, over half a million people enrolled

in home study job advancement courses.

Are you working toward the security you and your family need and deserve? *You can do this by making spare time self-improvement time.* It isn't too late to train for a successful career because in home study age is no barrier.

If you are in work you like, but want to progress faster, you can apply what you learn while you are studying.

American School, founded in 1897 as an educational institution not for profit, has helped many thousands of other ambitious people earn more while they learned more. TODAY you can make the big decision of your life. Check, fill out and mail coupon today. (Check more than one if you are undecided as to which appeals most.)

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| <input type="checkbox"/> Blueprint Reading | <input type="checkbox"/> Electricity—Practical | <input type="checkbox"/> Retail Merchandising |
| <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> Electronics—Industrial | <input type="checkbox"/> Salesmanship—Outside |
| <input type="checkbox"/> Business Management | <input type="checkbox"/> HIGH SCHOOL COURSES | <input type="checkbox"/> Sheet Metal Work |
| <input type="checkbox"/> Civil Engineering | <input type="checkbox"/> Machinists | <input type="checkbox"/> Tool Making |

NAME _____ OCCUPATION _____

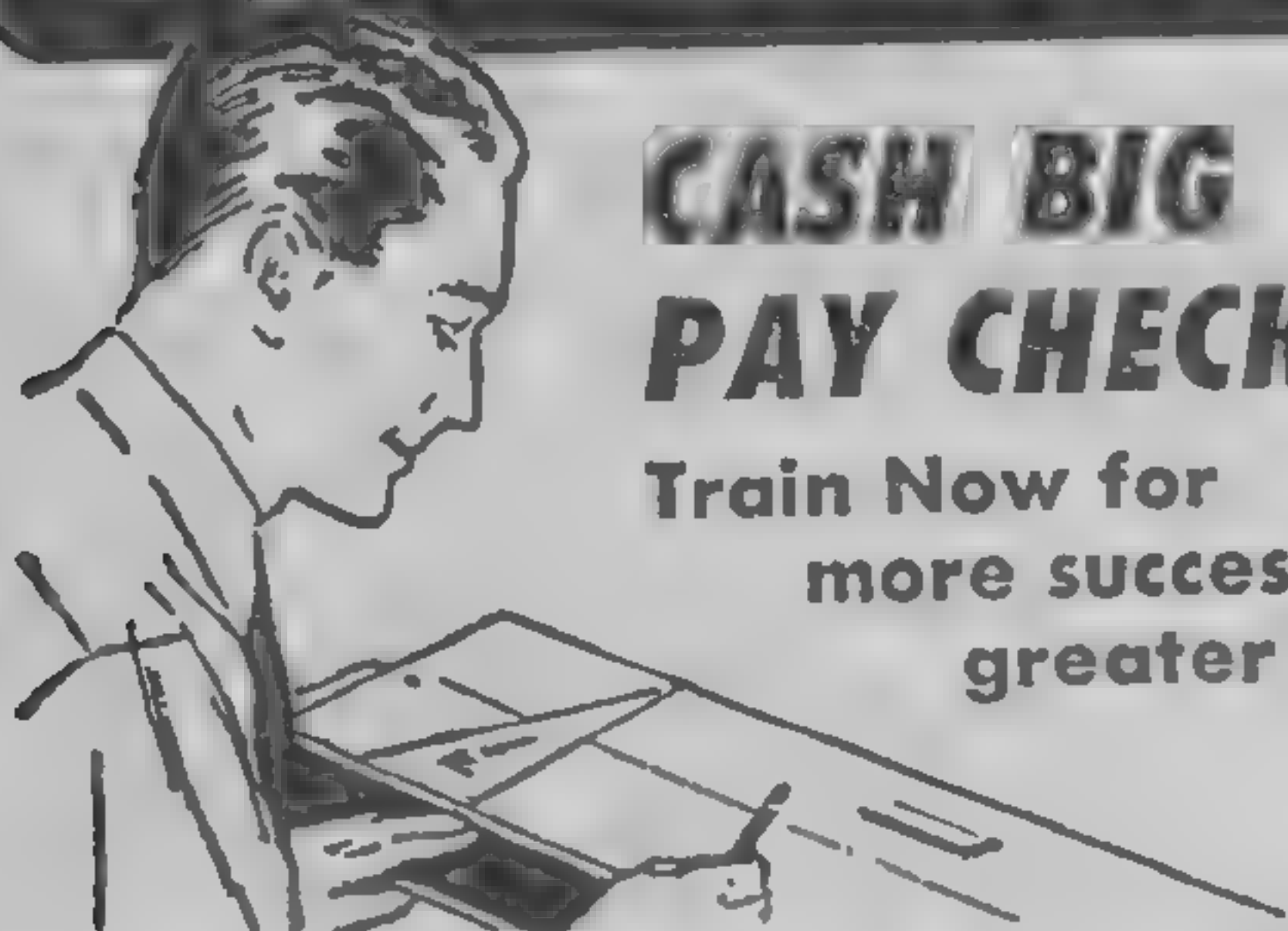
HOME ADDRESS _____ AGE _____

CITY _____ STATE _____

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The sooner
you ACT,
the sooner
YOUR GOAL
can be
REACHED

DRAFTSMEN



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(or at college in Chicago)

Check the want ads in any newspaper—SEE the big-pay opportunities open to you as a draftsman. What's more, you can learn this well-paid, prestige profession at home—quickly, easily! No special talent needed! Get complete, step-by-step Chicago Tech lessons in the mail, spend a few pleasant hours studying each week. In a short time you'll be a well-trained draftsman, ready to take your pick of many good jobs. Act now!

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B-263 Tech Bldg., 2000 So. Michigan Ave.
Chicago 16, Illinois

Mail me FREE lesson with facts about big opportunities in DRAFTING.

Name..... Age.....

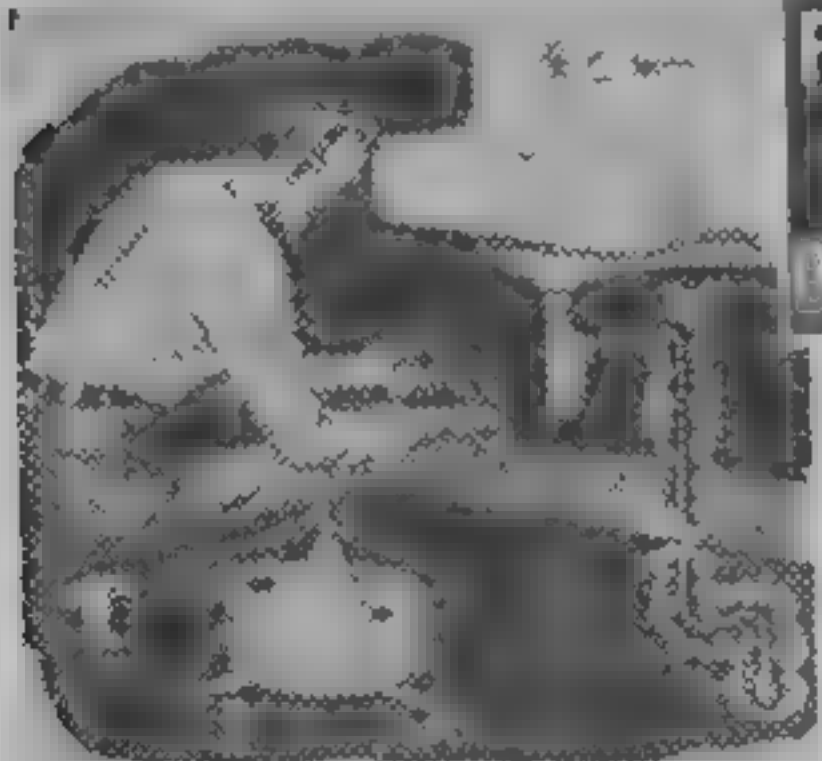
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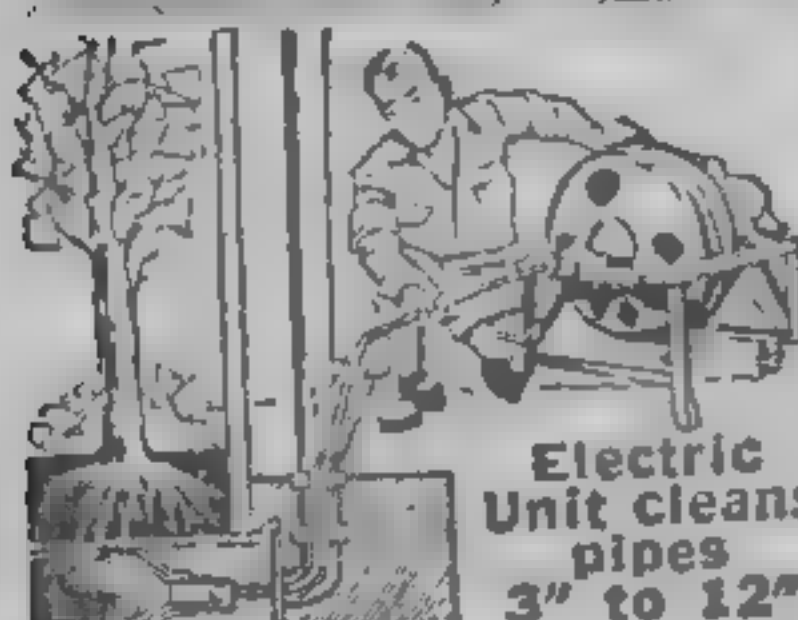
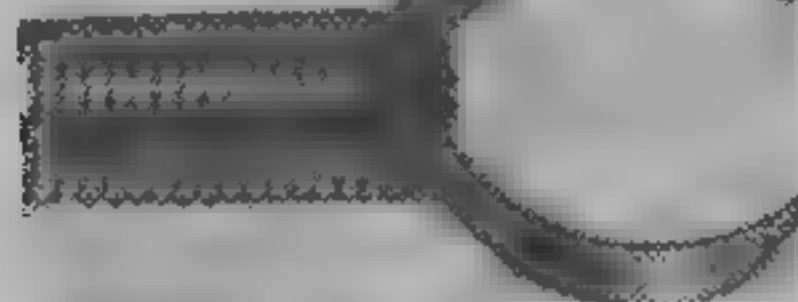
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Splendid opportunities. Prepare in spare time. Practical basic training. Long-established school. Send for free book, "Opportunities in Photography." No obligation.

American School of Photography, 835 Diversey Parkway, Dept. 1732, Chicago 14, Ill.



Attachable
Cutter Blades



Electric
Unit cleans
pipes
3" to 12"

Miller Sewer Rod, Dept.

FREE CLOGGED SEWERS REMEMBER THE BOOK COSTLY PLUMBING BILLS

Chicago—Jan. 1st. Just introduced is a Free Booklet on machines which enable the Home Owner, Janitor or Factory Maintenance Man to Rod-it-himself—

Yet anyone can operate this new Rodding Tool which is whirled down the drain in a few seconds. SINKS, BATHTUBS, TOILETS, URINALS, FLOOR DRAINS, HOUSE TO STREET SEWERS can be cleared of Rags, Grease, Paper, Sand while Cutter blades can be added for removing roots. A new discovery in Swedish Music Wire gives the rod 100% more Flexibility.

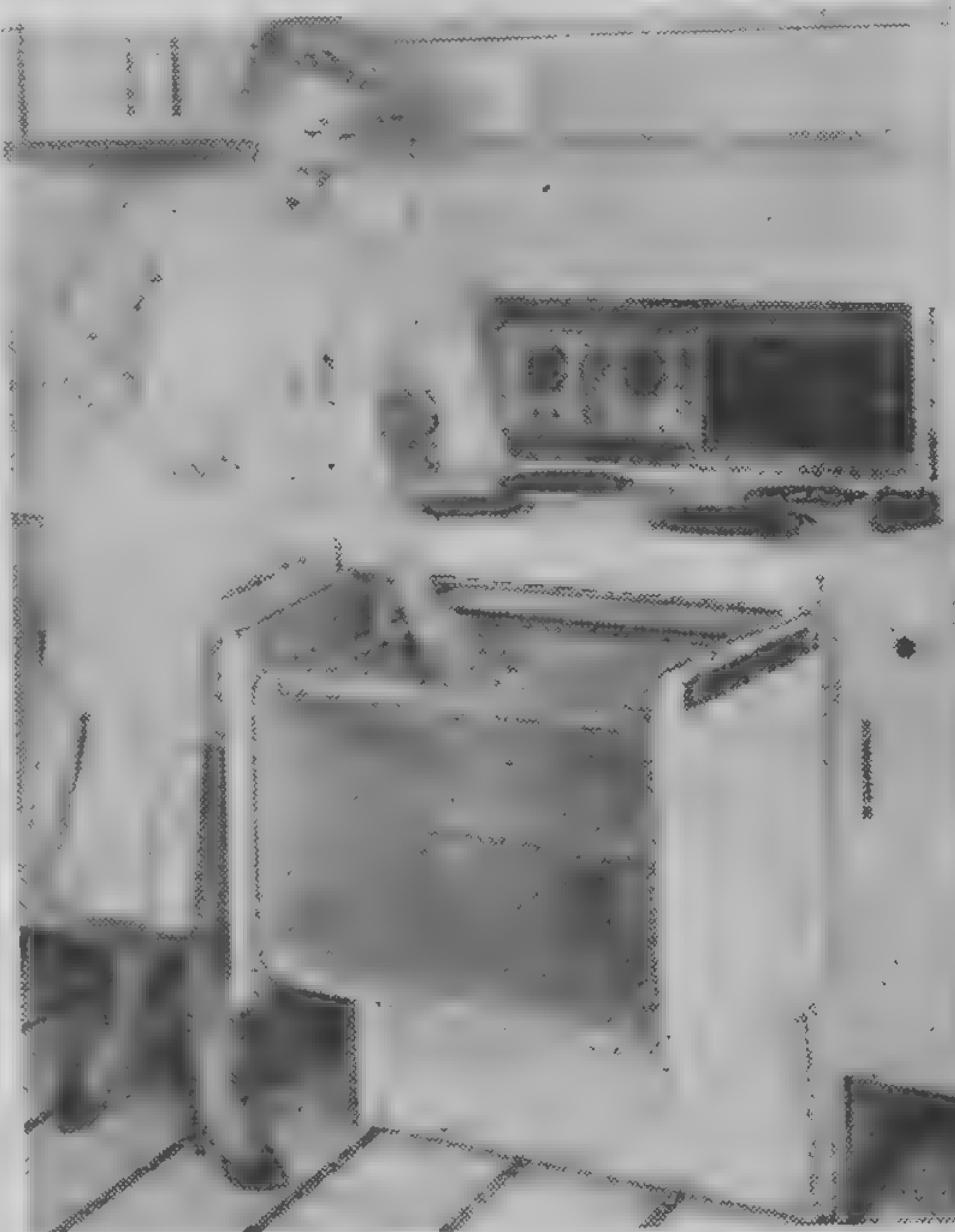
Another new unit is the Miller Electric Rodder which has patented cutters that expand automatically to the size of the pipe. It will clean out heavy obstructions in pipe diameters 3" to 12". Smaller Sizes available. But now, what are these Tools worth in COSTLY PLUMBING BILLS SAVED. Tear This Ad out—and write your name and address beside it for FREE BOOKLET on Hand and Electric Units. Obey that urge. No Agent will call. A postcard will do (Chicago Phone Kildare 5-1702).

SR-2, 4640 N. Central, Chicago 30, Ill.

at \$5.45, the *Auto-Erase* is manufactured by the Sanford Ink Co., Dept. EL, 2740 Washington Blvd., Bellwood, Ill.

Easy Access Range

• French doors on the Frigidaire 30-in. electric range allows the homemaker to stand close to the range when loading or unloading. Open one door and the other opens with it, automatically. For cleanup, the oven pulls forward, supported by



the doors. The heating unit remains inside, leaving an open top for cleaning as shown in the photo.

Interchangeable switch knobs are easily removed and back panel wiped clean. Made in Deluxe (\$269.95), Custom Deluxe (\$329.95) and Custom Imperial (\$429.95) models, the ranges are made in white, with colors optional at additional cost for the Deluxe and Custom Imperial models.

Wood Picture Kits

• Wood inlaid pictures like the one shown, can be made by anyone, without experience or tools. Assembled like a jigsaw puzzle from over 65 different woods, the kits include all necessary woods, borders, panels and patterns, plus instruction folder.

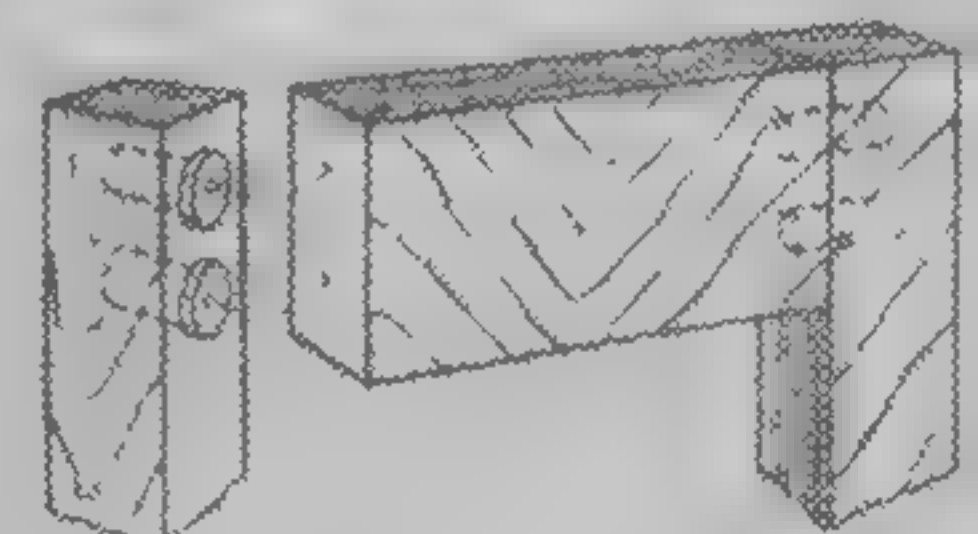
Available are six different subjects, including a mountain-lake scene and a map of the United States, ranging in completed size from 12½ by



16 in. (\$8.95) to 13¾ in. information may be had from Constantine and Son, Inc., 1500 Chester Road, New York 16, N. Y.

Quick Spotter

• Doweling is fast and accurate. Dowel centers are used to find the desired location in one of four joined and insert a dowel.



Press the other piece of wood against the center point marks indicate drilling dowel holes.

The 98¢ set consists of 1/8-in. and 1/4-in. dowel centers. Metal Products Co., 421 E. 34th St., N. Y. 17.

Out-of-Sight

• The TV-Receptor, when attached to the TV power cord, is said to bring in sharp, clear pictures without the aid of rabbit-ears or outside antenna. Receptor draws signals from the electric wiring, though the coupler, does not require piercing of the insulation.

To install, connect the receptor lead to the set's antenna terminals. Press the button on the receptor to open a switch so the power cord passes. Then the spot providing the best reception. Manufacturer, Jerrold Electronics Corp., 15th and Lehigh Ave., Philadelphia 19, Pa.

se is manufactured by the
pt. EL, 2740 Washington

Access Range

the Frigidaire 30-in. electric
maker to stand close to the
unloading. Open one door
with it, automatically. For
ells forward, supported by



ing unit remains inside, leav-
r cleaning as shown in the

switch knobs are easily re-
panel wiped clean. Made in
Custom Deluxe (\$329.95) and
429.95) models, the ranges are
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and Custom Imperial models.

Picture Kits



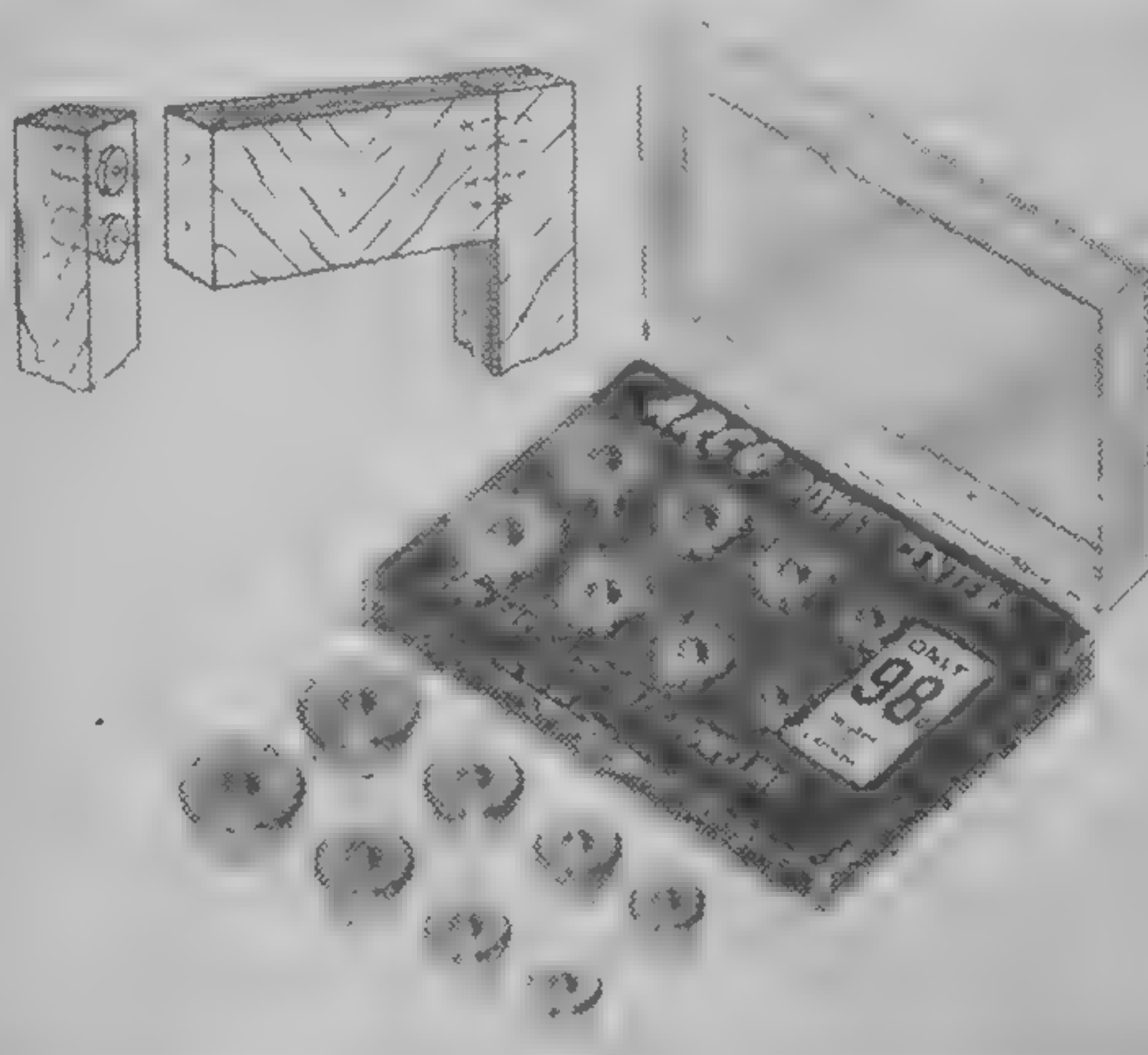
nels and patterns, plus instruc

x different subjects, including
cene and a map of the Unite
completed size from 12½ b

16 in. (\$8.95) to 13¾ by 22 in. (\$11.95). More
information may be had from the supplier, Albert
Constantine and Son, Inc., Dept. AMD, 2050 East-
chester Road, New York 61, N. Y.

Quick Spotters for Dowels

• Doweling is fast and accurate when Arco
dowel centers are used. Just drill a hole at de-
sired location in one of two pieces of wood to be
joined and insert a dowel center of proper size.



Press the other piece of wood in its proper place
against the center point and tap lightly. Punch
marks indicate drilling point for the opposite
dowel holes.

The 98¢ set consists of two each of ½-, ¾-, 5/16-
and ¼-in. dowel centers. They're made by Arrow
Metal Products Co., 421 W. 203 St., New York
34, N. Y.

Out-of-Sight TV Antenna

• The TV-Recep-
tor, when attached
to the TV power
cord, is said to
bring in sharp,
clear pictures
without the aid of
rabbit-ears or out-
side antenna. Re-
ceptor draws sig-
nals from the
electric wiring,
though the coupler,
does not require
piercing of the in-
sulation.

To install, con-
nect the receptor
lead to the set's
antenna terminals.
Press the button

the receptor to open a slot through which the
power cord passes. Then slide the receptor to
the spot providing the best reception. The manu-
facturer, Jerrold Electronics Corp., Lav. Div.,
15th and Lehigh Ave., Philadelphia 32, Penna.,



**MEN! Make up to
\$1,000.00
IN A MONTH!**

without "SELLING"

Sensational Demand for Low-Priced Fire
Alarm PLUS Sure-Fire "No-Selling" Plan
Offers Ambitious Men Huge
Profit Opportunities

AMAZING NEW INVENTION



Even beginners who never sold any-
thing in their lives are cleaning up
unbelievable profits with the first prac-
tical effective, low priced Fire Alarm
ever invented . . . needed, wanted in
homes, factories, offices, stores, on
farms, for boats, everywhere. Profes-
sional salesmen are making biggest
profits in years! Later in this ad I'll
tell you about the plan that's pro-
ducing orders for 1 to 12 Fire Alarms
per sale from 8 out of 10 prospects . . .
without selling. Here are the facts
about the Fire Alarm. It hangs on the
wall like a picture—no wiring, no in-
stallation. It's always on guard . . .
It 'smells' a fire before danger point.
When temperature rises, Fire Alarm
goes off automatically, howls loud warn-
ing that can be heard 1/5 mile, wakes
up soundest sleeper, give precious time
to put out fire, call fire department, or
escape. And it sells for only \$4.95 with
profit up to \$2.70 on each one.

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With our field-tested plan customers sell
themselves. No cold canvassing. No hard
selling. It's the nearest thing to 'Auto-
mation Selling.' Imagine a sales plan even
a child can use successfully because the sales
tools we give you (and which you leave with your
prospects) do all your selling even while you
sleep! No room here to give you all the details but
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Sensitive! Lighted
match triggers
Alarms in 3 sec-
onds.

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moneymaking facts,
complete Illustrated
Sales Kit, every-
thing you need to
make money your
first day. Learn how
selling only 20 Fire
Alarms a day pays

Made \$26.52 in 3 Hours!

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first
shipment
about
noon. Worked 3
hours and made
\$26.52 profit. It's
a terrific seller!"
—Stanley



you \$1,080.00 profit in a month. No competition anywhere.
Get in on the ground floor now. Rush this coupon.

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(ALARM DIVISION)

114 E. 32nd St., Dept. F-28H New York 16, N. Y.

ALVIN WESLEY, Sales Manager
Merlite Industries, Inc. (Alarm Division)
114 E. 32nd St., Dept. F-28H, New York 16, N. Y.

Rush FREE SALES KIT and full details about your "No-
Selling" plan which gives me opportunity to make up to
\$1,000.00 in a month without cold canvassing and hard selling
—automatically. I am not obligated.

Name _____

Address _____

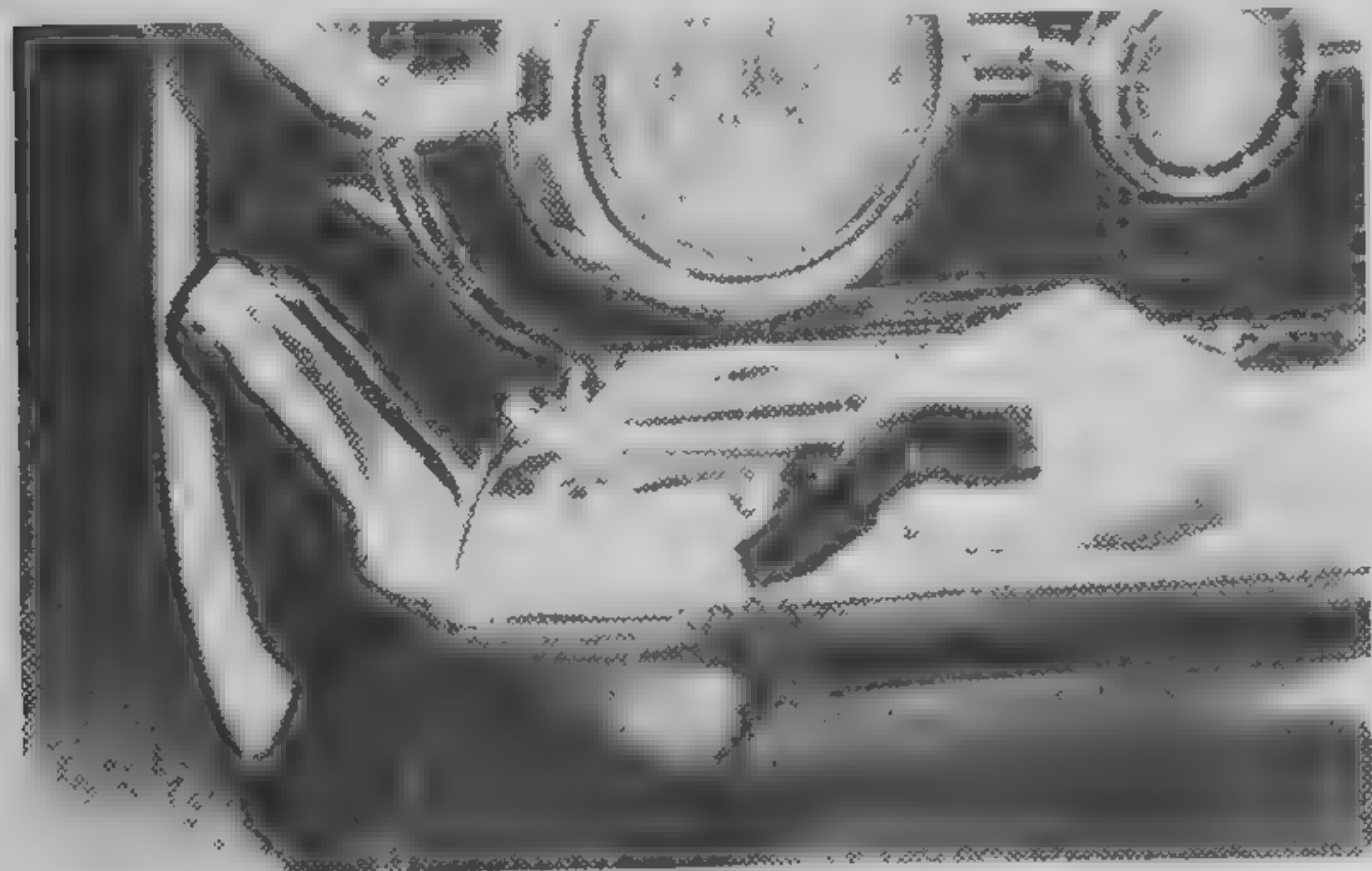
City _____ Zone _____ State _____

In Canada: Mopa Co., Ltd., 371 Dowd St., Montreal 1, P.Q.

says the unit also may be used for FM radios. Priced at \$5.95, the receptor is available at most appliance dealers.

"Stick" Type Cleaner

- By dipping the *Rust Buster* stick in water, then rubbing it over the rusted surface, the manufacturer says you can "erase" rust from chrome-

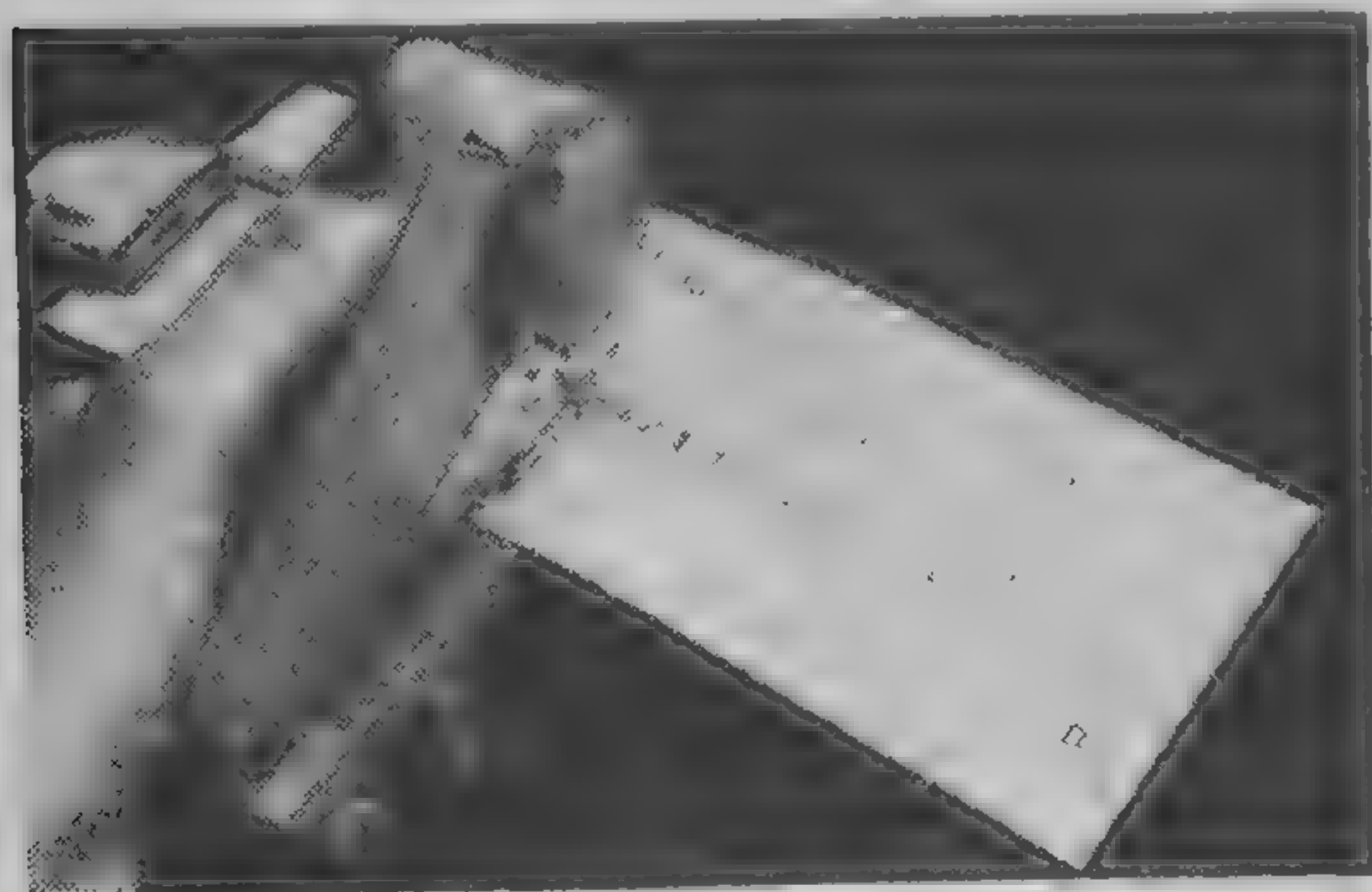


plated surfaces. Stick will also clean bugs from car bodies or windshields or remove spots from vinyl and linoleum. Composition of the 98¢ stick is the secret of the manufacturer, Magic Iron Cement Co., Inc., Dept. PP, 5403 Bower Ave., Cleveland 27, Ohio.

Small Business Check Writer

- The prestige and protection offered by a check writer is now available for \$9.95. Check writer will emboss any sum on any sized check in red indelible ink; it comes with a plastic case, an extra roller and a supply of ink.

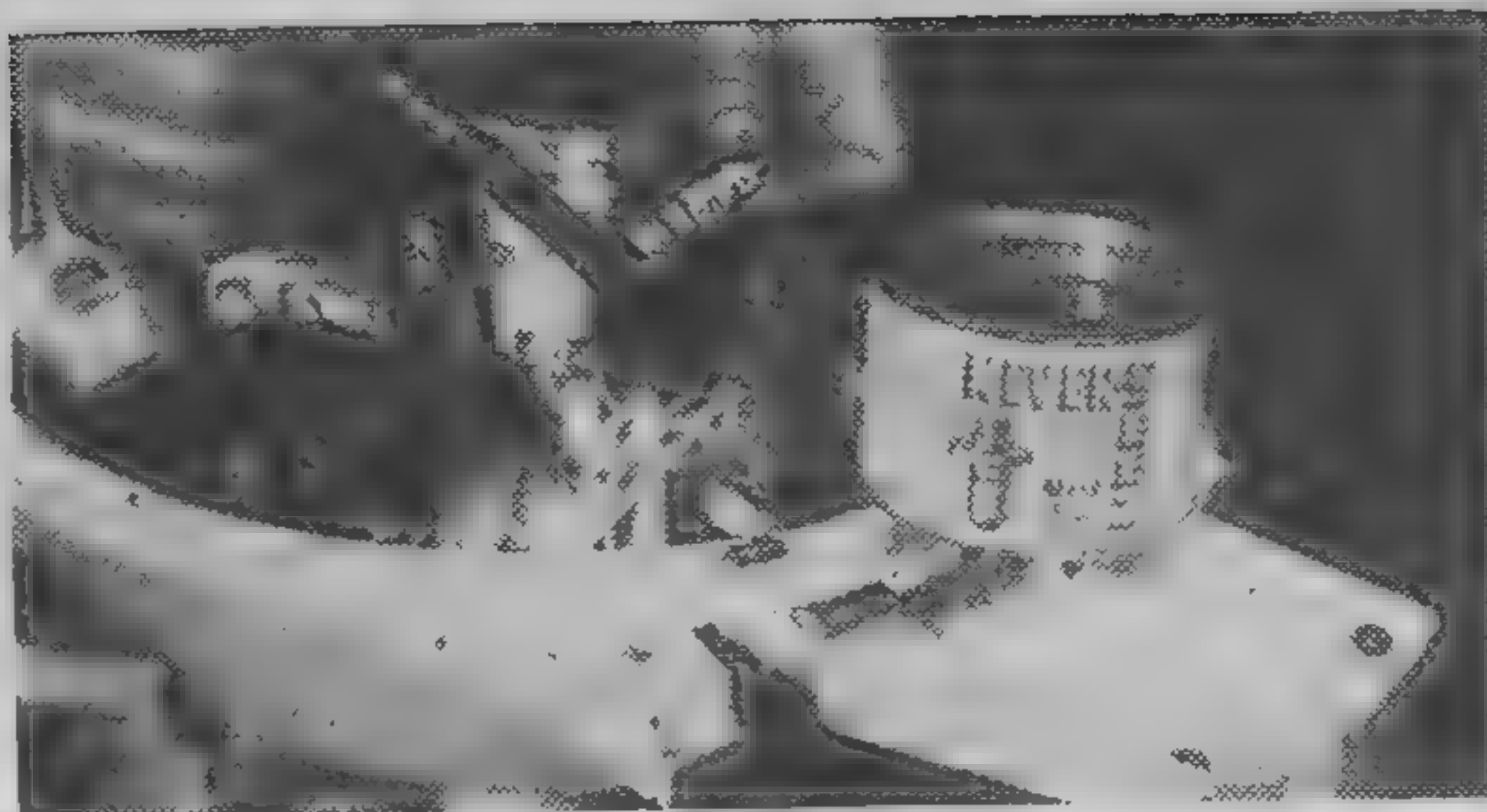
To use, just slip the check in place, set the dial for the desired word or figure and compress



the jaws. Reset the dial to the next word or figure desired and again compress. Distributed by Arne W. Lunke & Co., Rm. 318, 913 Forest Ave., Evanston, Ill.

Compound Protects Against Corrosion and Seizure

- *Never-Seez* acts as a protective coating on metals, sealant, lubricant and anti-seize compound. Product has a melting point of over 2000°F, above temperatures normally found in engines and machinery. It does not settle or change texture through heat and exposure. The



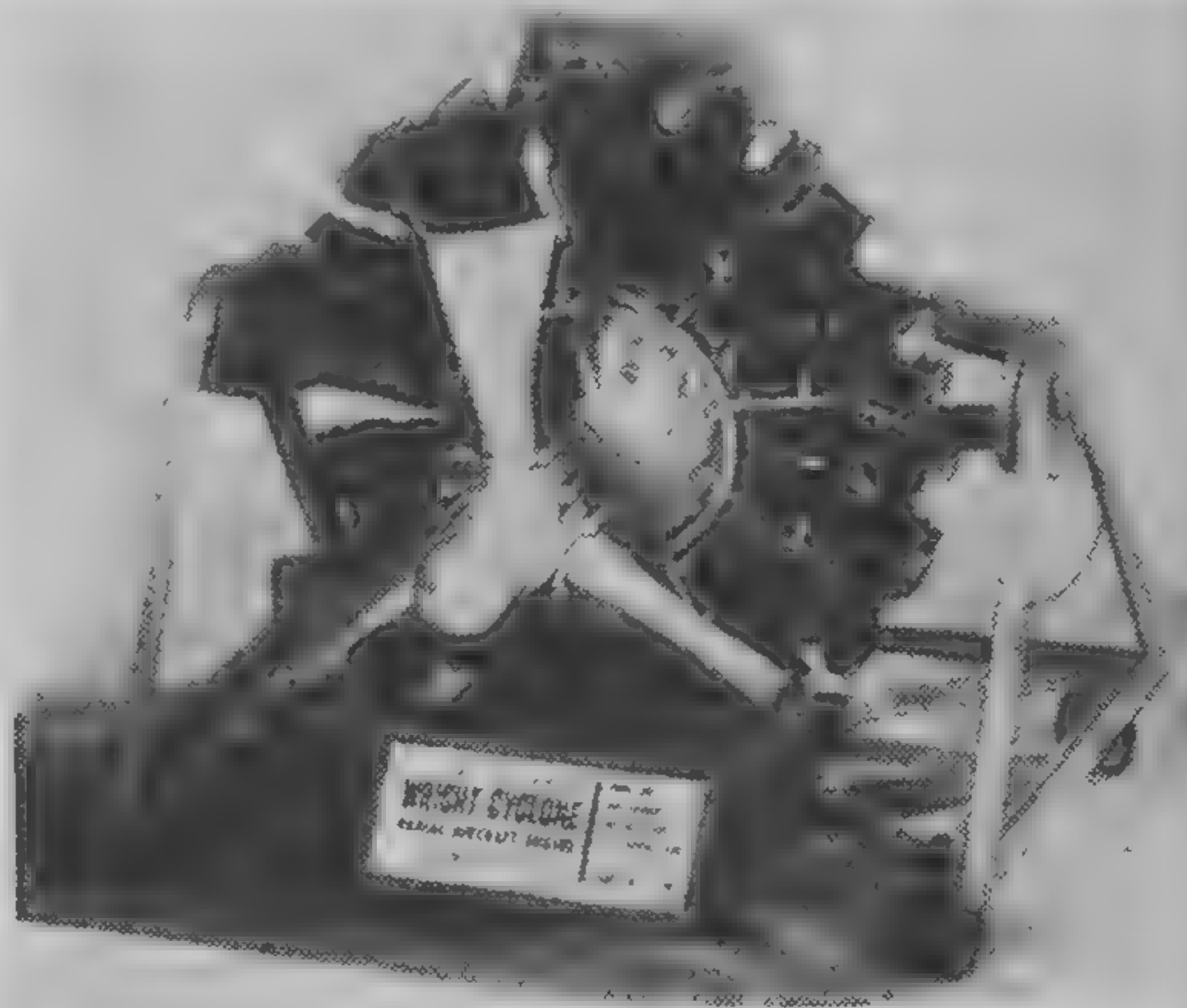
material also is said to be non-electrolytic, insoluble in fresh or salt water and inert to rubber. Nor will it evaporate or harden.

A Canadian product, *Never-Seez* is distributed in the U. S. by Ireco, Inc., Dept. JRH, 109 North Main, Wilmington, Ill., is sold in one-pound (\$3.95) and 1/3-pound (\$1.75) units.

Model of the Wright Cyclone

- A cut-away of a cylinder is the feature of this one-inch scale model of the Cyclone nine cylinder engine that has powered more than 50 planes, including the DC-3 and the B-17. By turning the prop on the model, the piston and con rod will move. The 88-piece kit was developed from engineering drawings supplied by Curtiss Wright.

The engine is molded in five colors of plastic and is furnished at \$1.98 with an adjustable service rail dolly. The kit is also available with



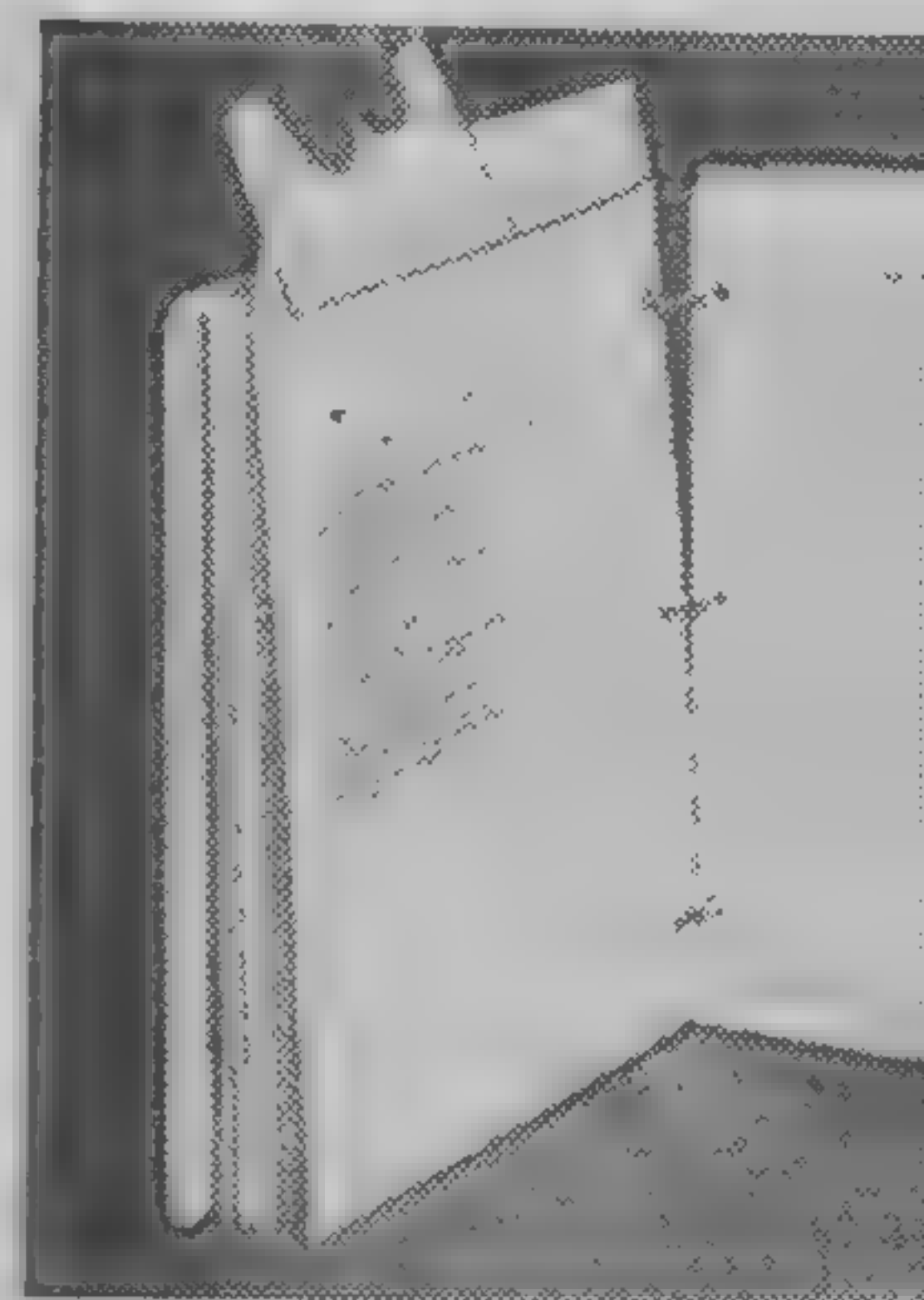
a power pack (\$2.98 less batteries) that will demonstrate prop and piston movement. Kits are manufactured by Monogram Models, Aircraft Div., 3421 West 48th Place, Chicago, Ill.

Tax Records for Individuals

- *Howard's Tax Saver* is a tax information collector that will help you pay the tax collector only what is due him. The artificial leather binder holds 15 kraft envelopes which separate types of income, deductions, employees' expenses, cost of dependents and other pertinent information.

Receipts and papers are filed in the proper envelopes, an inventory is kept on the face of

each envelope and the re- guidance for that parti- nances. Two blank env- category that is particu-



figuring times comes ar- at hand. Priced at \$2.95 from Charles-Howard & University Ave., Indiana,

Two-Sided Ad

- Called *Dubl-Stik*, a r- visibly does such jobs as packages, holding shelf pa- in albums. To use, just ap- of the decoration, remove- in place. Soon available in- for a 196-ft. roll plus conv- by Kleen-Stik Products, L- Wilson, Chicago, Ill.

Time-Piece for Lan

- This Ship's Wheel is a key- wound wall pen- dulum clock. The small sailboat above the number 12 rocks back and forth on the wave- patterned dial while the anchor- pendulum weighs everything down. Made of plastic, the clock has a built-in key holder and co- red or cocoa color. Price- \$9.50, the clocks are avail- erprises, 163-S Mansion

Versatile Dra

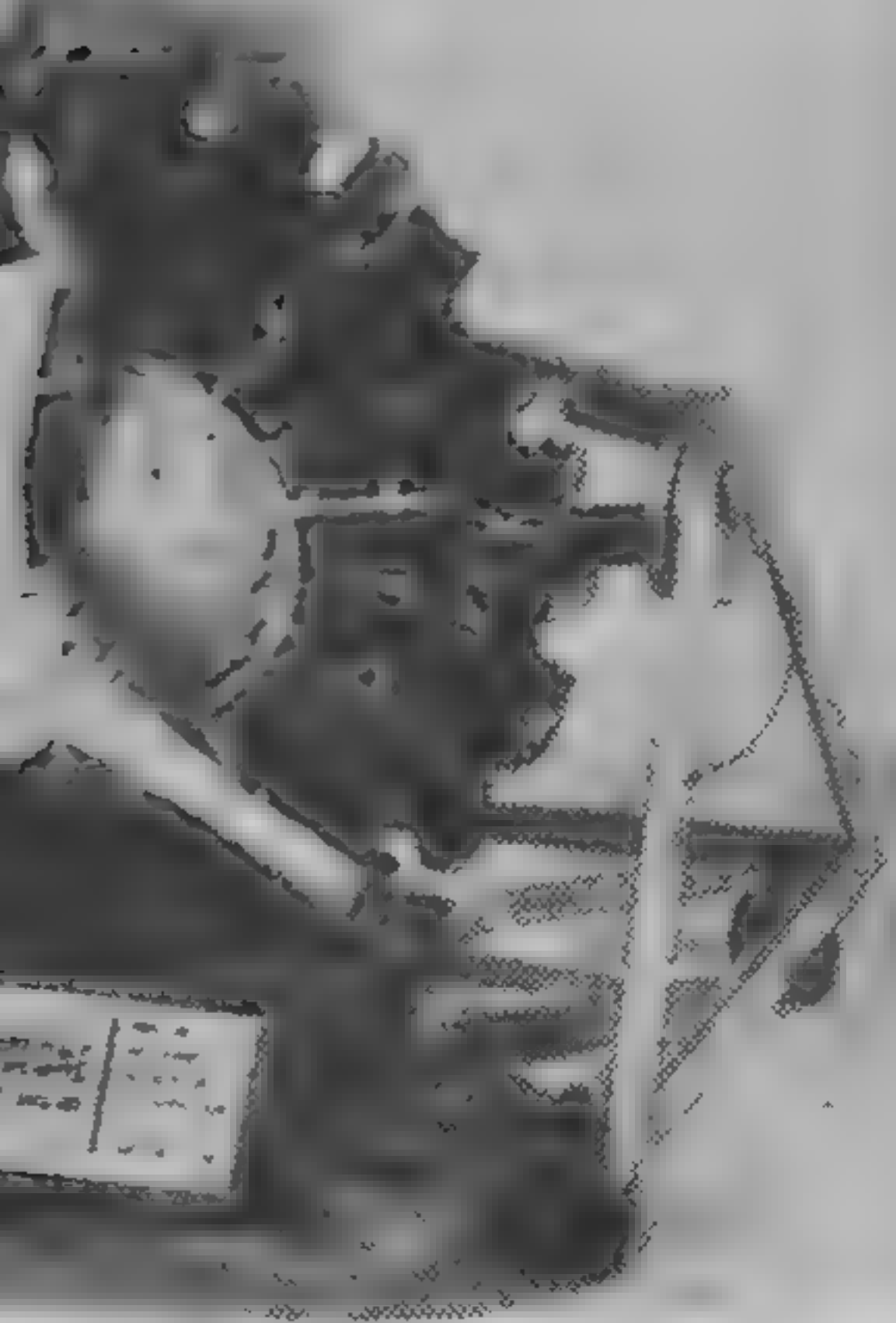
- Combining the jobs of ruler, parallels and angles i- Rule. Two of the identical 4-in. scales in 16ths; the e- half 10ths for decimal dim-ipping wheels mounted i- rument permits the rule



to be non-electrolytic, in-
alt water and inert to rub-
orate or harden.
t, Never-Seez is distributed
Inc., Dept. JRH, 109 North
Ill., is sold in one-pound
(\$1.75) units.

Wright Cyclone

ylinder is the feature of this
of the Cyclone nine cylinder
ered more than 50 planes,
and the B-17. By turning the
the piston and con rod will
kit was developed from en-
supplied by Curtiss Wright.
ded in five colors of plastic
\$1.98 with an adjustable
he kit is also available with



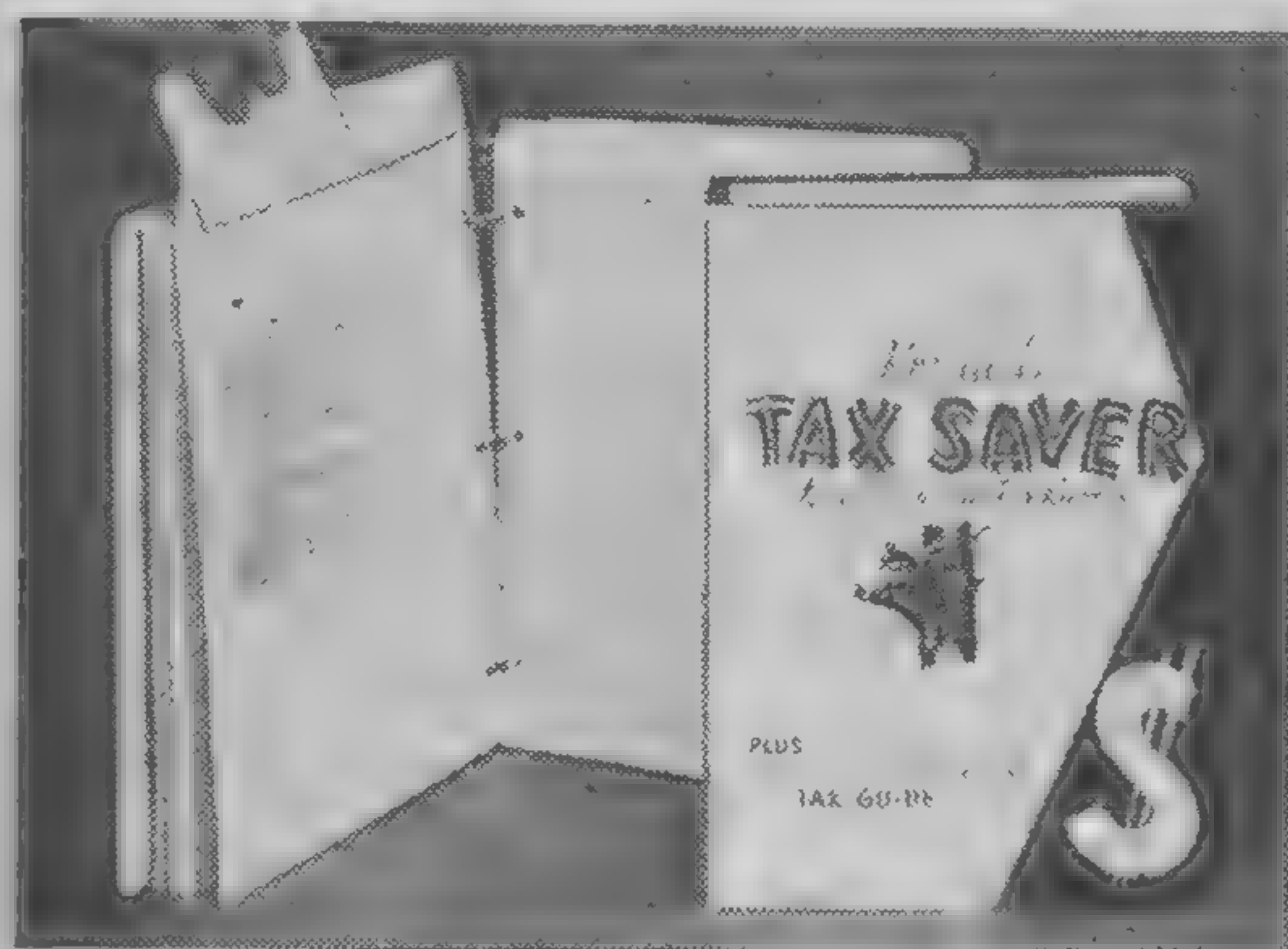
.98 less batteries) that will
and piston movement. Kits
y Monogram Models, Aircraft
th Place, Chicago, Ill.

ds for Individuals

ver is a tax information col-
lp you pay the tax collector
him. The artificial leather
aft envelopes which separate
eductions, employees' expenses,
and other pertinent informa-

pers are filed in the proper
ntory is kept on the face of

each envelope and the reverse side furnishes tax
guidance for that particular phase of your fi-
nances. Two blank envelopes take care of any
category that is particularly large. When tax-



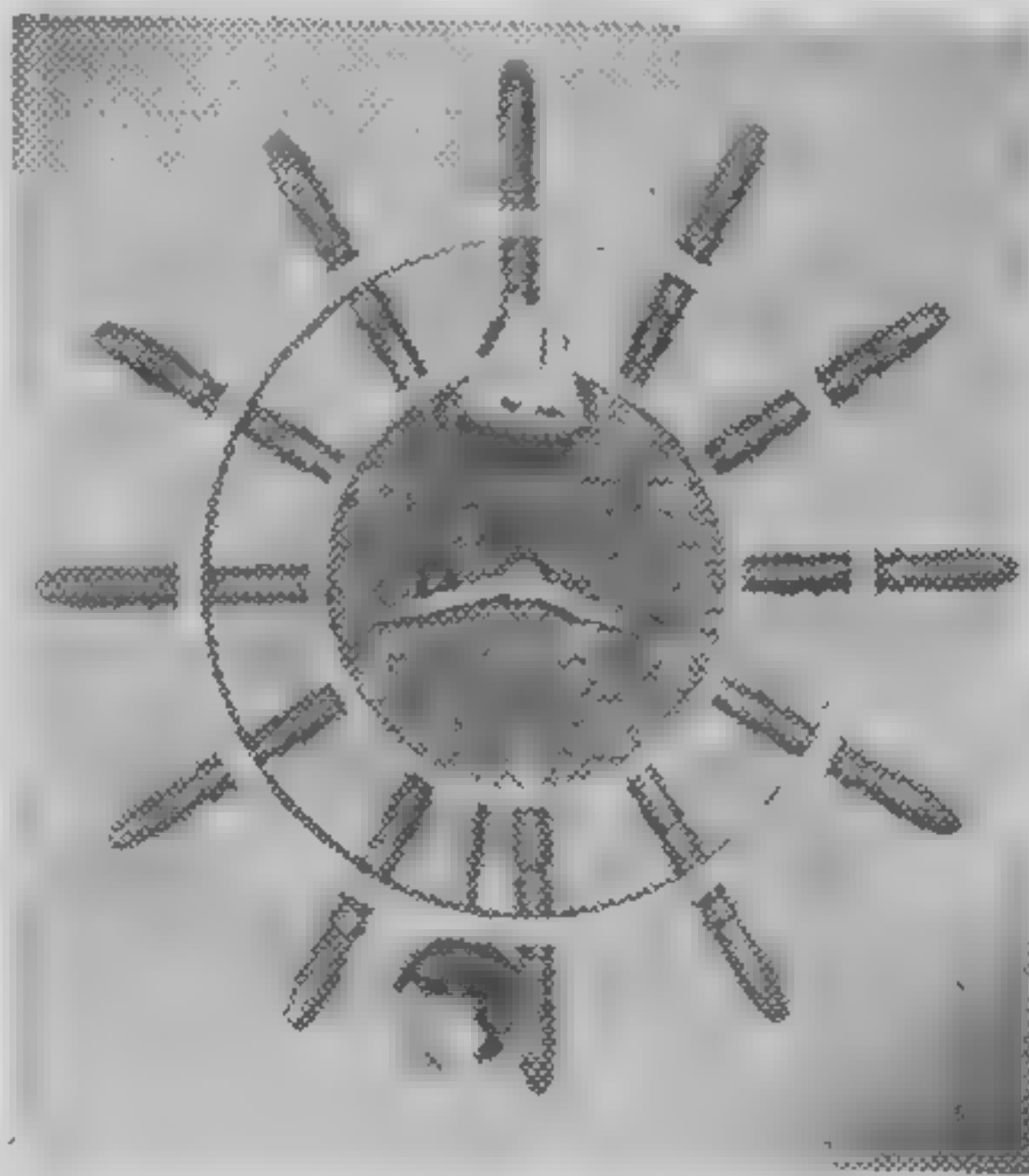
figuring times comes around, all needed info is
at hand. Priced at \$2.95, the book is available
from Charles-Howard & Co., Dept. TYG, 5935
University Ave., Indianapolis 19, Ind.

Two-Sided Adhesive Tape

- Called *Dubl-Stik*, a new adhesive tape in-
visibly does such jobs as keeping decorations on
packages, holding shelf paper in place, and photos
in albums. To use, just apply the tape to the back
of the decoration, remove the backing and press
in place. Soon available in stationery stores at \$3
for a 196-ft. roll plus convenient dispenser. Made
by Kleen-Stik Products, Inc., Dept. 601, 7300 W.
Wilson, Chicago, Ill.

Time-Piece for Landlocked Seamen

- This Ship's
Wheel is a key-
wound wall pen-
ulum clock. The
small sailboat
above the number
12 rocks back and
forth on the wave-
patterned dial
while the anchor-
pendulum weighs
everything down.
Made of plastic,
the clock has a
uilt-in key holder and comes in choice of blue,
red or cocoa color. Priced at \$4.98 or two for
\$9.50, the clocks are available from Empire En-
terprises, 163-S Mansion St., Coxsackie, N. Y.



Versatile Drafting Tool

- Combining the jobs of protractor, compass,
ruler, parallels and angles is the job of the *Proco-
Rule*. Two of the identically beveled edges have
in. scales in 16ths; the end edges are scales in
1/10ths for decimal dimensioning. A pair of
slipping wheels mounted in the center of the in-
strument permits the rule to roll and still hold

NOW! The Secrets of WOOD CARVING Revealed by an Expert

Now you can carve beautiful figurines and ornaments that
friends will envy! It's easier than you think. All the "tricks
of the trade" are revealed in a brand new book, "The Art of
Wood Carving," by John Upton. (He has made carvings for
many prominent people, including Pres. Eisenhower.) No expe-
rience necessary. Clear text, with over 120 how-to illustrations,
shows you step by step how to transform a bare piece of wood
into a "work of art." Everything is explained: how to prepare
drawing, select wood, what tools to use, exactly how to pro-
ceed from rough carving to finish. How to make carved panels;
how to stain, gild, etc. The perfect hobby for young or old—
it's fast, easy, and fun. No elabo-
rate tools or workshop needed.
Some make nice extra income in
spare time.



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today! D. Van Nostrand Co., Inc.,
Dept. 222A, 120 Alexander St.,
Princeton, N. J. (Established 1848)

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D. Van Nostrand Company, Inc., Dept. 222A
120 Alexander Street, Princeton, N. J.

Please send me *The Art of Wood Carving* for FREE exami-
nation. After 10 days I will either return it with no obligation
at all; or keep it and remit \$1.50, plus small shipping cost,
and \$2 monthly for 2 months.

Name

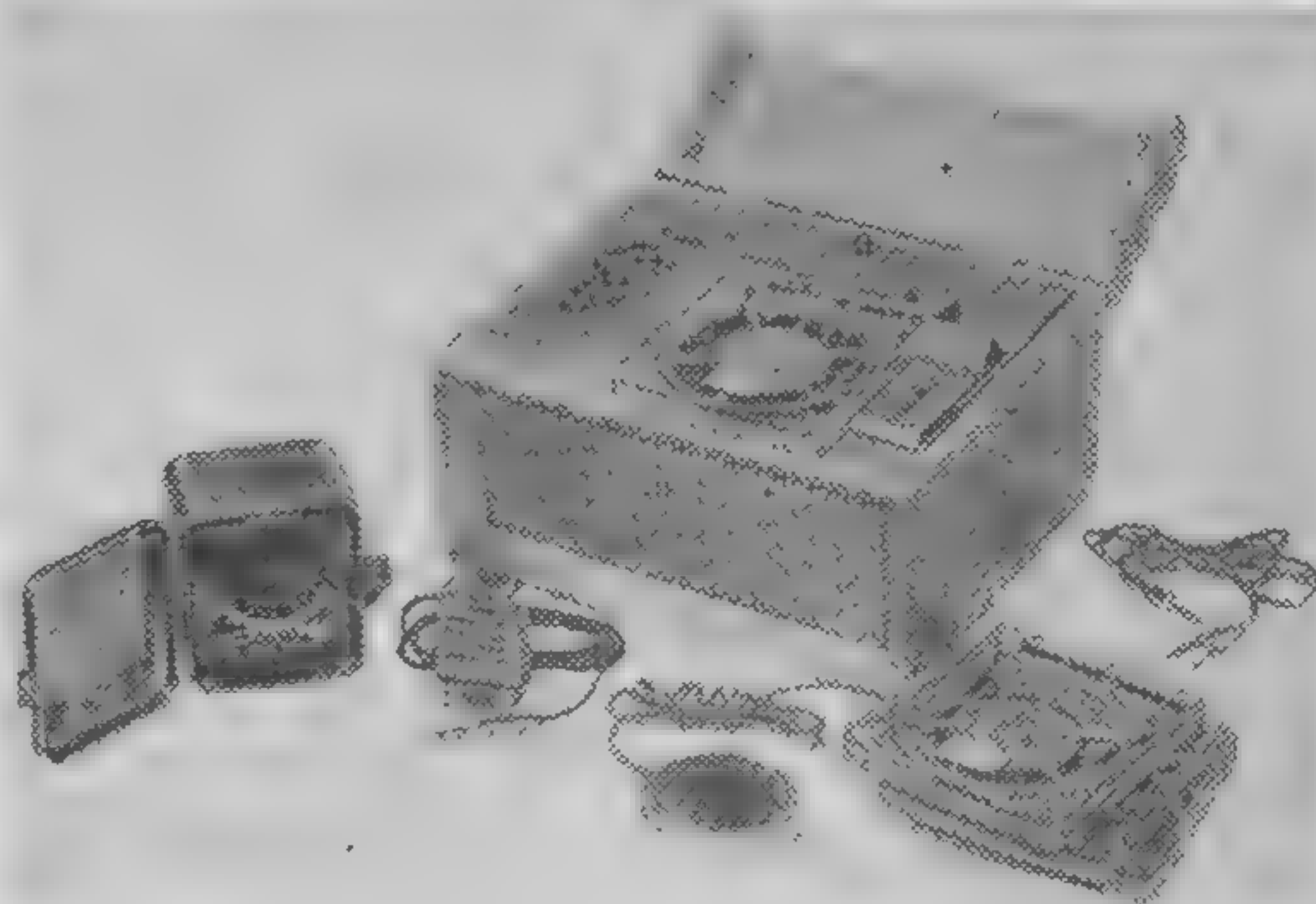
Address

City Zone State

☐ **SAVE!** Check here if you enclose \$5.50 WITH this coupon.
Then WE prepay all shipping costs. Same 10-day return-
for-refund guarantee.

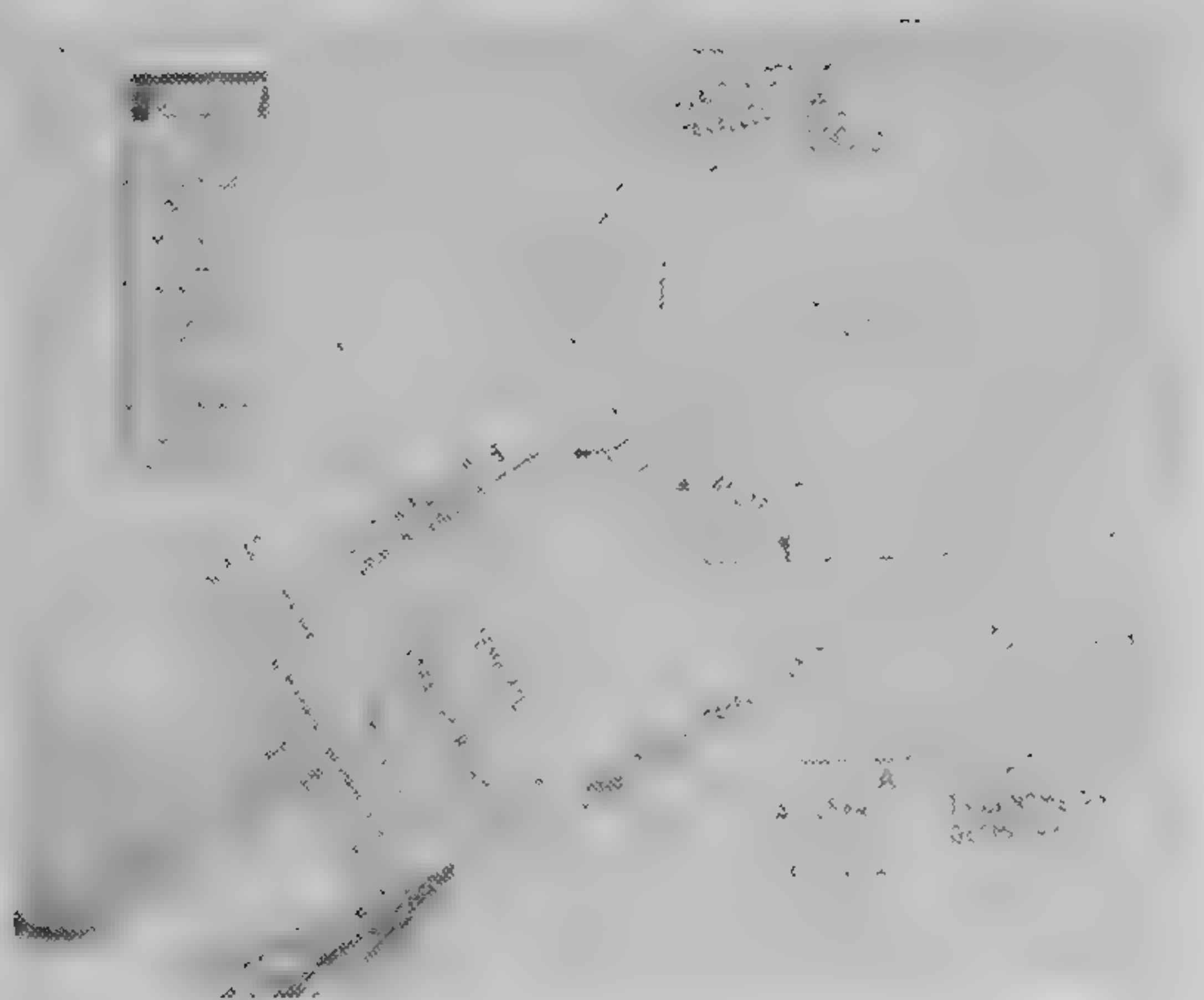
(In Canada: 25 Hollinger Road, Toronto 16. Price slightly higher.)

The Amazing Electronic Educator!



The Electronic Educator is an amazing new scientific device
designed to train and teach at both the conscious and subcon-
scious levels. You read, speak or transcribe recorded material
thru the microphone, where it is recorded on special endless
tape cartridges holding from 1 min. to 2 full hours of tape. This
tape repeats itself and your message endlessly to give you the
necessary repetition to memorize material. Comes complete
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sands of uses from learning languages to helping backward stu-
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Research Ass'n. Box 24-C, Olympia, Washington.

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nique." Satisfaction guaranteed. Free descriptive folder
on request.



exact alignment. Also in the rule is a series of holes for use in drawing circles and another series variously sized from $\frac{1}{16}$ to $\frac{5}{16}$ in. In addition, protractor marks are etched into the 6 x 2-in. light green plastic unit.

\$1.10 sent to the Smith-Drake Corp., Dept. HJI, 1206 So. La Brea, Inglewood, Calif., will bring a sample tool to you.

Floor Wax Applicator

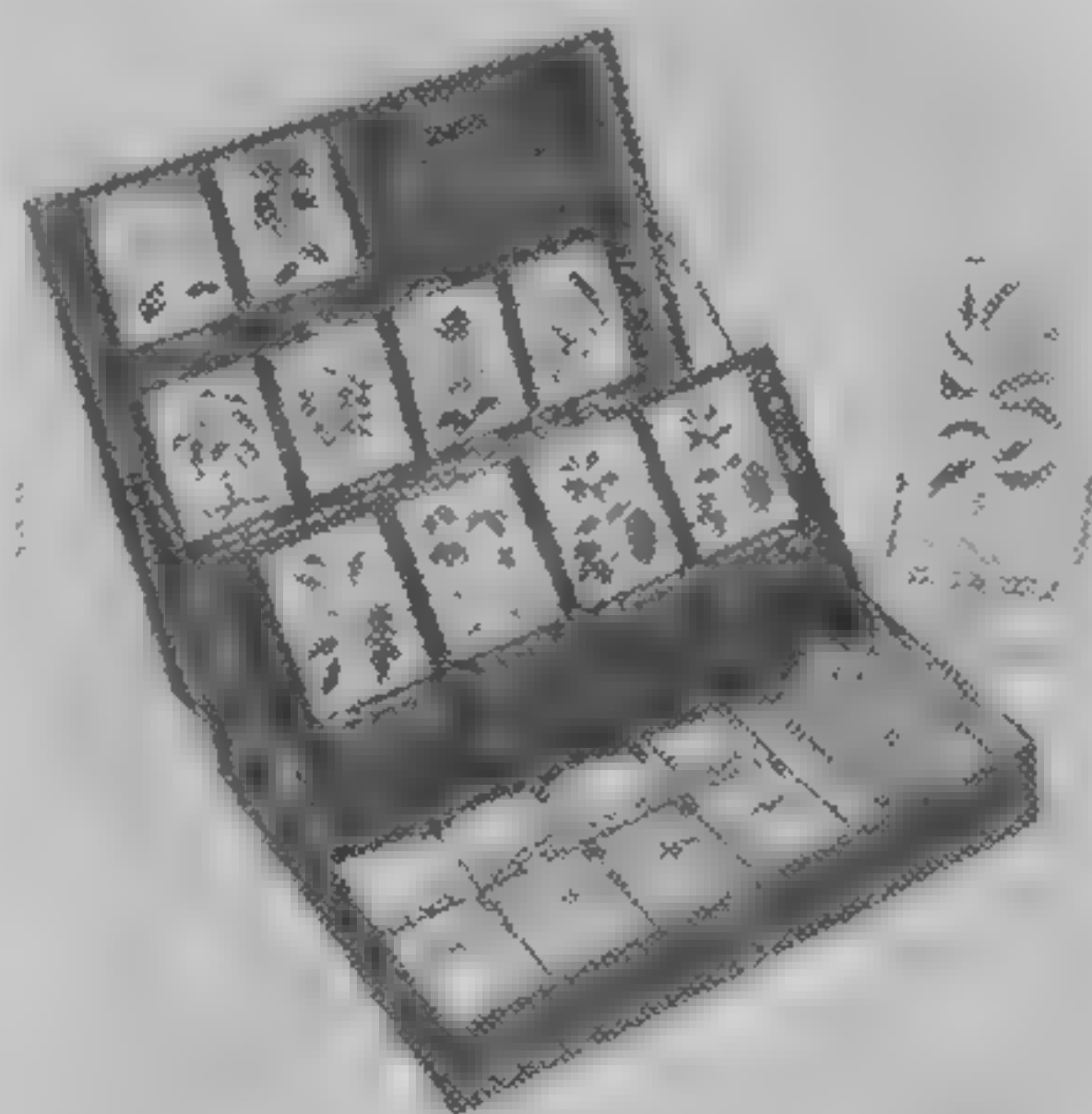
• The Fort Recovery W 10 wax applicator applies paste wax to the floor directly from any standard one-pound can of wax. After use, a protective cover plate slides over the felt bottom of the waxer. Priced at \$5.95, by Fort Recovery Industries, Inc., Dept. GGJ, Fort Recovery, Ohio.



Diagnosing Plant Nutritional Deficiencies

• The Profit Plant diagnostic kit contains a color chart which shows the general symptoms of 12 types of nutritional deficiency, such as iron or potassium deficiency, where the symptoms occur on the plant, the color of the foliage and indicates the general condition of health of the plant.

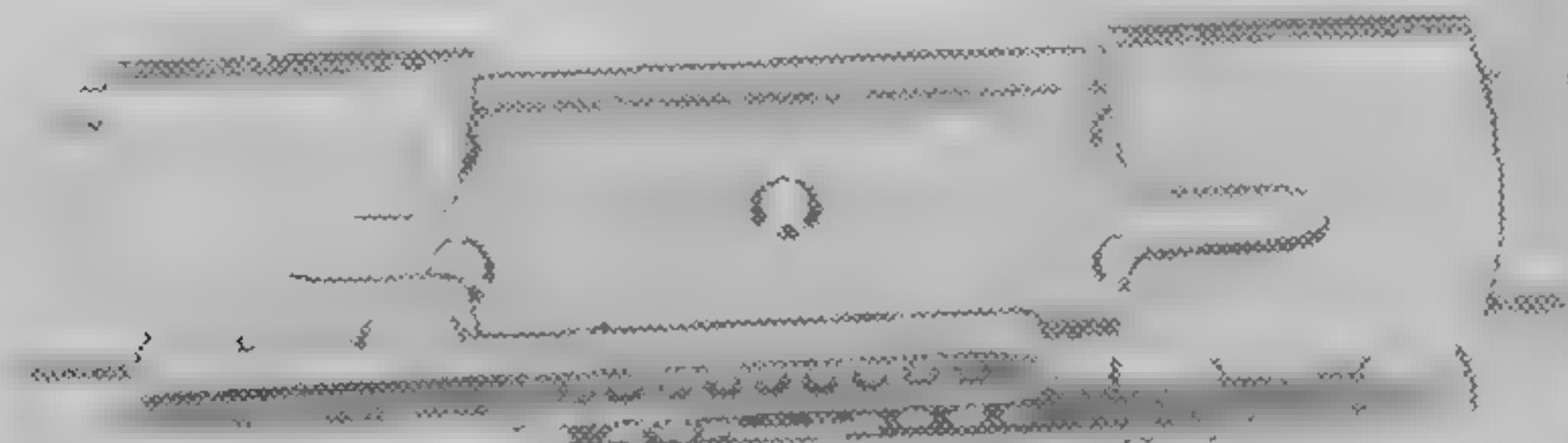
After the deficiency is tentatively identified by the pictures and instructions, a packet of the needed element (contained in the kit) is mixed



with water and either sprayed on the foliage or applied to the soil. Recovery of the deficient plant should be noted in a few days. Kits are priced at \$7.95 and refill packets are available at 5 for \$1. They are produced by Plant Science Prod. Co., P. O. Box 770-SM, Berkeley 1, Calif.

Locking the Outboard in Place

• Your outboard motor won't get away from you either through the activities of thieves or because of a couple of loose screws if you install



a Davy Jones Locker. Locker consists of a mounting plate, which is installed on and remains a part of the transom and a pair of slip panels which fit over the motor clamps. A padlock fastened through matching holes completes the setup. Priced at \$5.95, less padlock. Available wherever marine supplies are sold. Made by the Williams & Scott Co., Dept. NAA, Box 7429, No. Kansas City 16, Mo.

Fused Multiple Outlet Box



• The Safcorde outlet box contains 6 heavy-duty standard 120 v receptacles, an on-off switch to control the receptacles and a pilot light to indicate when voltage is on. Both sides of the line are fused to protect against

shorts or excessive loads. Unit carries a 10-ft heavy-duty appliance cord and is rated in excess of 10 amps.

Priced at \$9.95, the unit is available from Jane and Fallesen Enterprises, Dept. KDF, Box 25 Beechwood Station, Rochester 9, N. Y.

Blank Title Slides for 35mm Projectors

• If you can write, draw, trace or print you can liven your 35mm slide show with titles, maps and artistic touches of your own design in black or in color. Just place the designs on the blank slides now being introduced by Graflex, Inc. Dept. MD, Rochester, N. Y. Errors are removed by erasing and the slides may be reused. Available from any Graflex dealer, slides are priced at four for 79¢ or 25 for \$3.75.—P. D. URBAIN.

PERFECT L
Popular St



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GUIDES

Office, Store, Etc.
Mailboxes.
Sold at Hardware,
tionery, Variety,
Supply Stores. If
STENSO, ask him to
order directly from

Old English

Set No. 212
1 - 1 1/4 - 2 1/4 inch Capital, Lower Case letters & numbers (11 stencils).....\$1.75

FRONTIER

Set No. 214
1/2 - 3/4 - 1 - 1 1/2 - 2 - 2 1/4 inch Capital letters & numbers (11 stencils).....\$1.75

Modern Script

Set No. 215
1/4 - 1 - 1 1/2 - 2 inch Capital, Lower Case letters & numbers (9 stencils).....\$1.75

LARGE GOTHIC



r sprayed on the foliage or
Recovery of the deficient
ed in a few days. Kits are
refill packets are available
produced by Plant Science
770-SM, Berkeley 1, Calif.

Outboard in Place

tor won't get away from you
activities of thieves or be-
loose screws if you install



the motor clamps. A pad-
h matching holes completes
\$5.95, less padlock. Available
plies are sold. Made by the
Dept. NAA, Box 7429, No

Multiple Outlet Box

- The Safcorde outlet box contains 6 heavy-duty standard 120 v receptacles, an on/off switch to control the receptacles and a pilot light to indicate when voltage is on. Both sides of the line are fused to protect against overloads. Unit carries a 10-ft power cord and is rated in excess of 1000 watts.

he unit is available from Jane
erprises, Dept. KDF, Box 25
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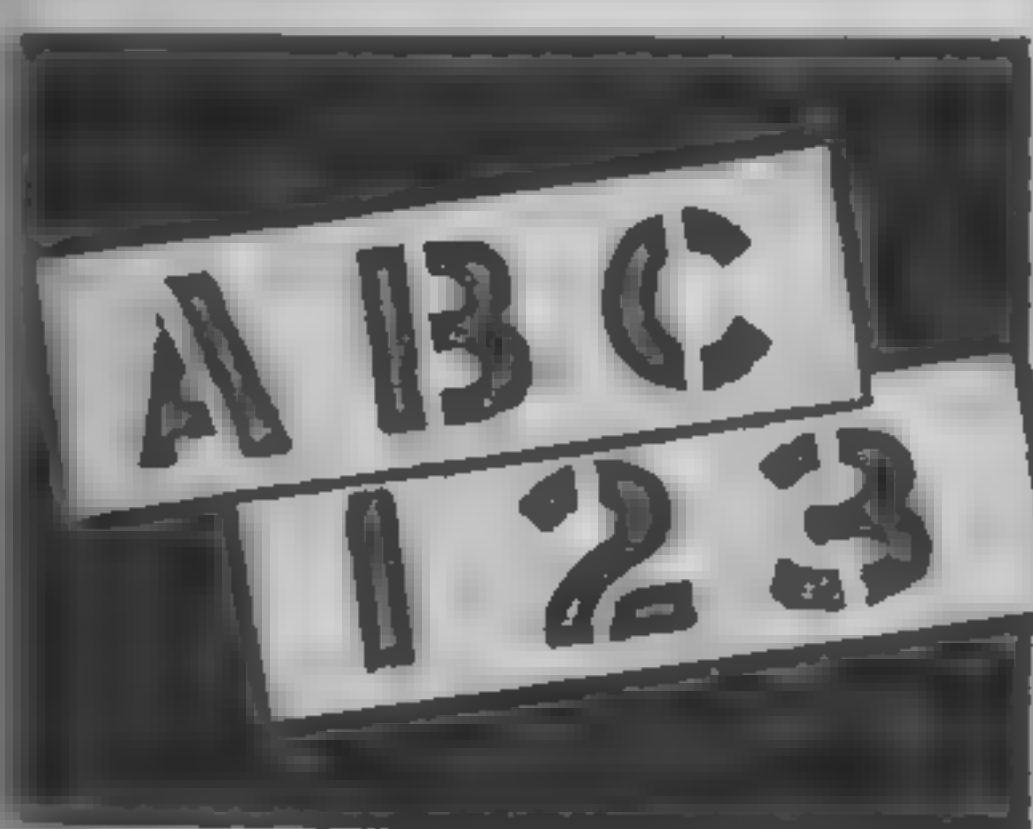
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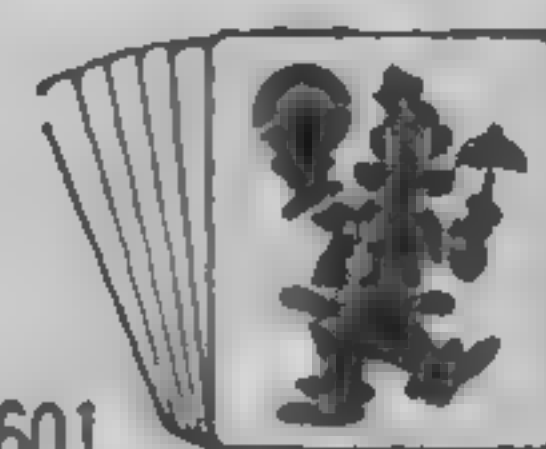


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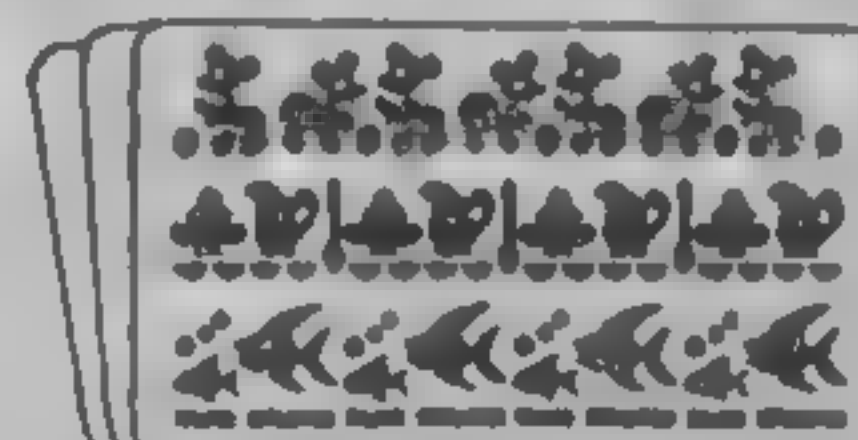


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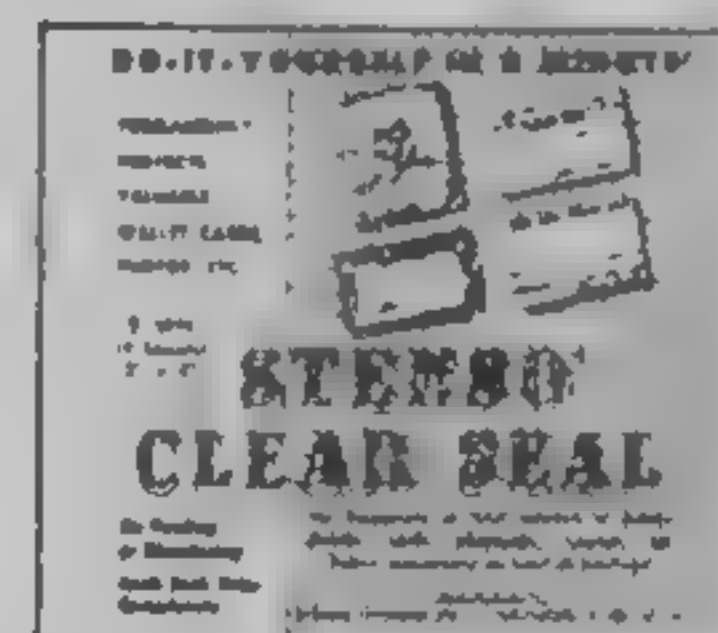
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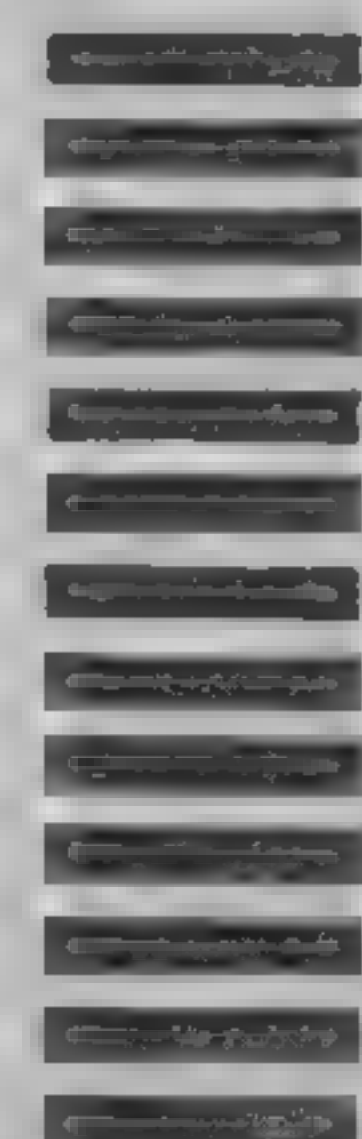
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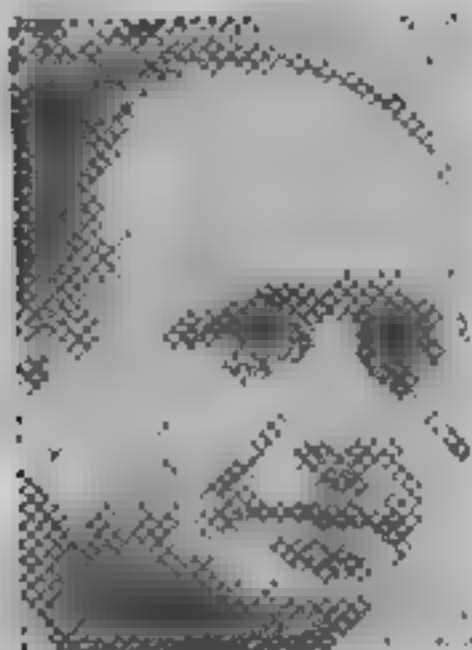
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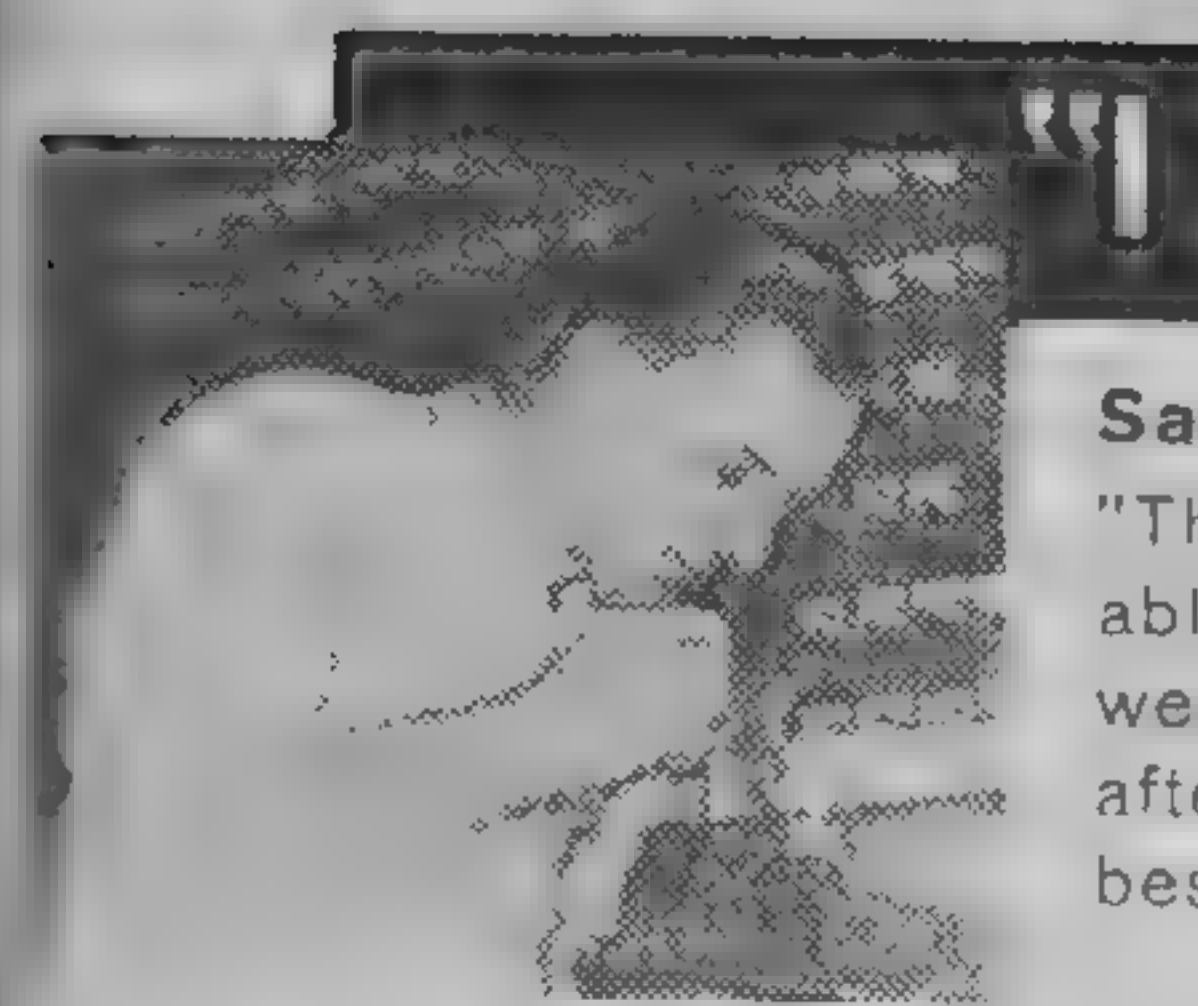
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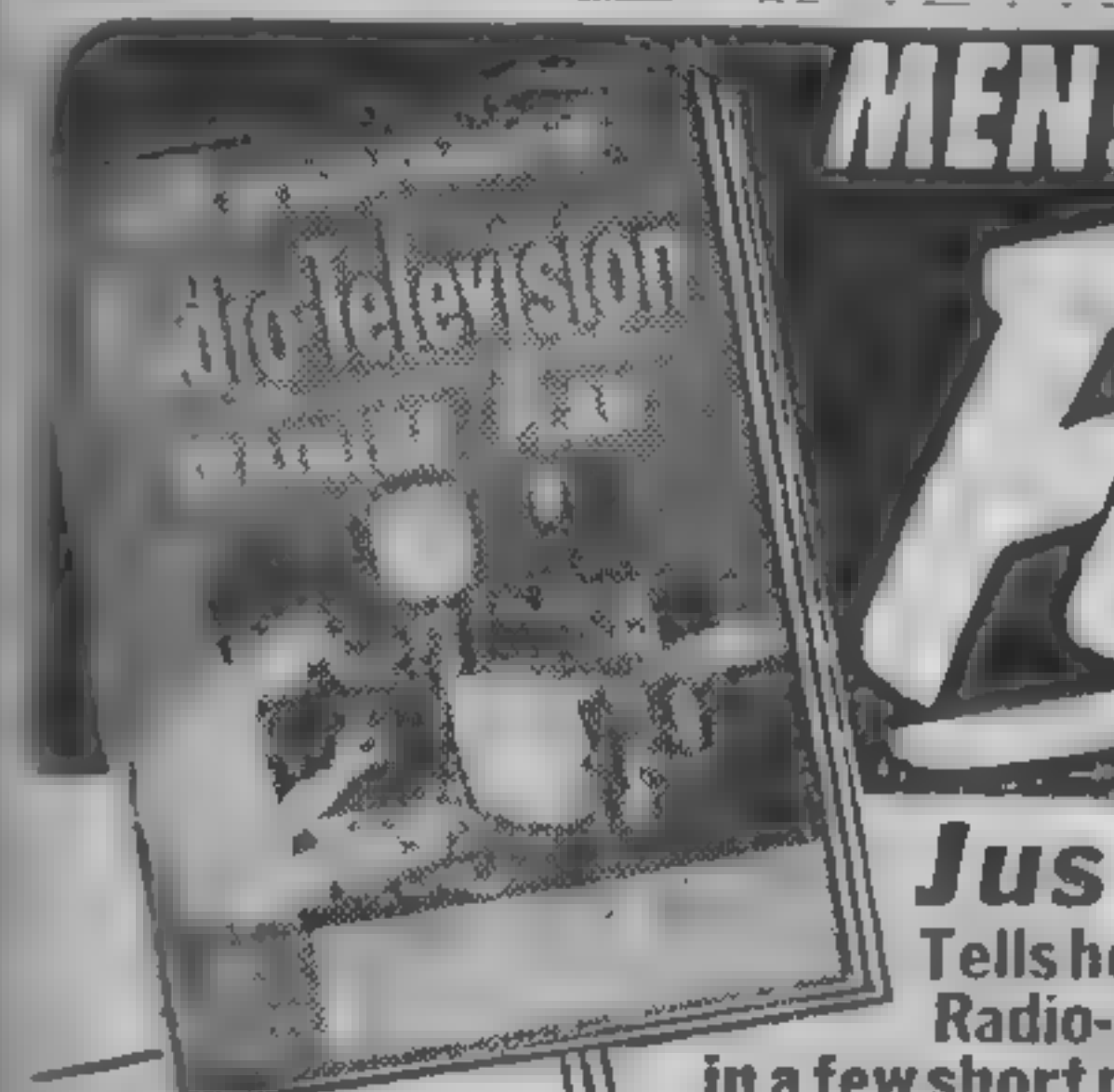
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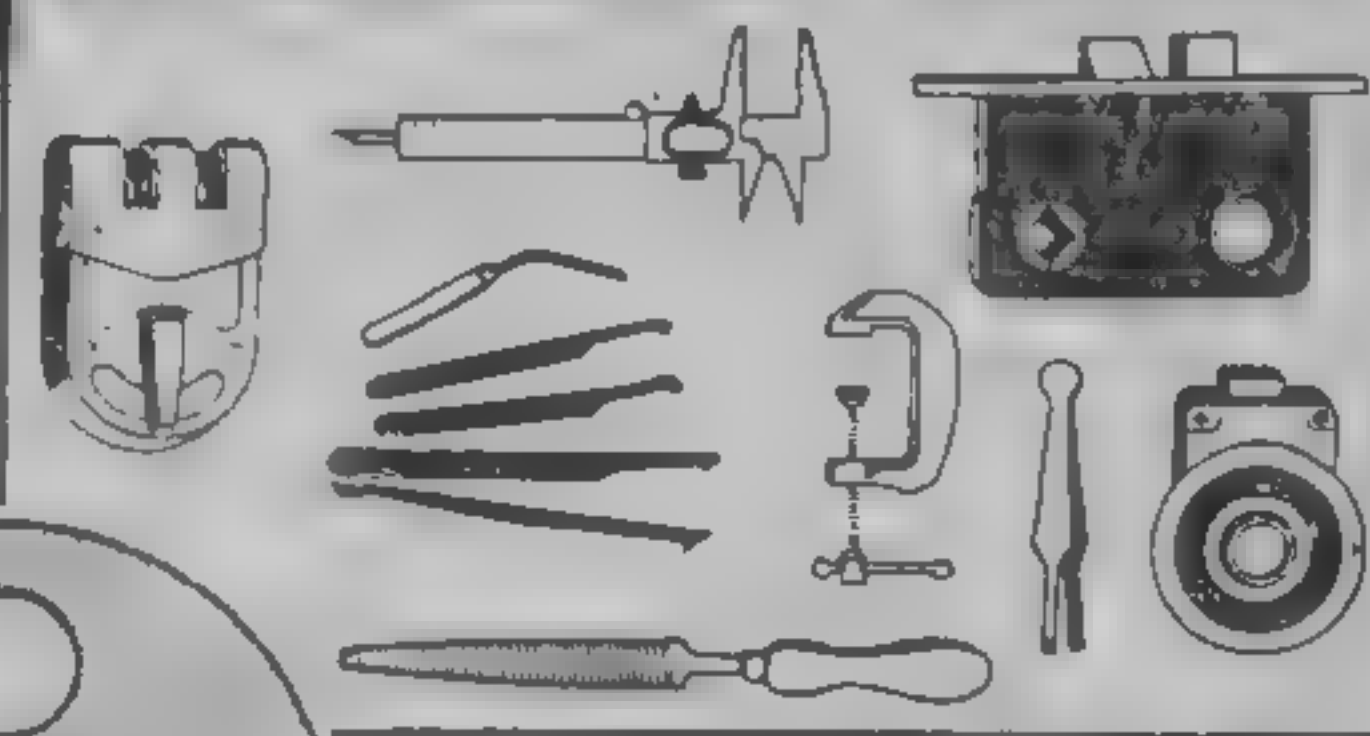
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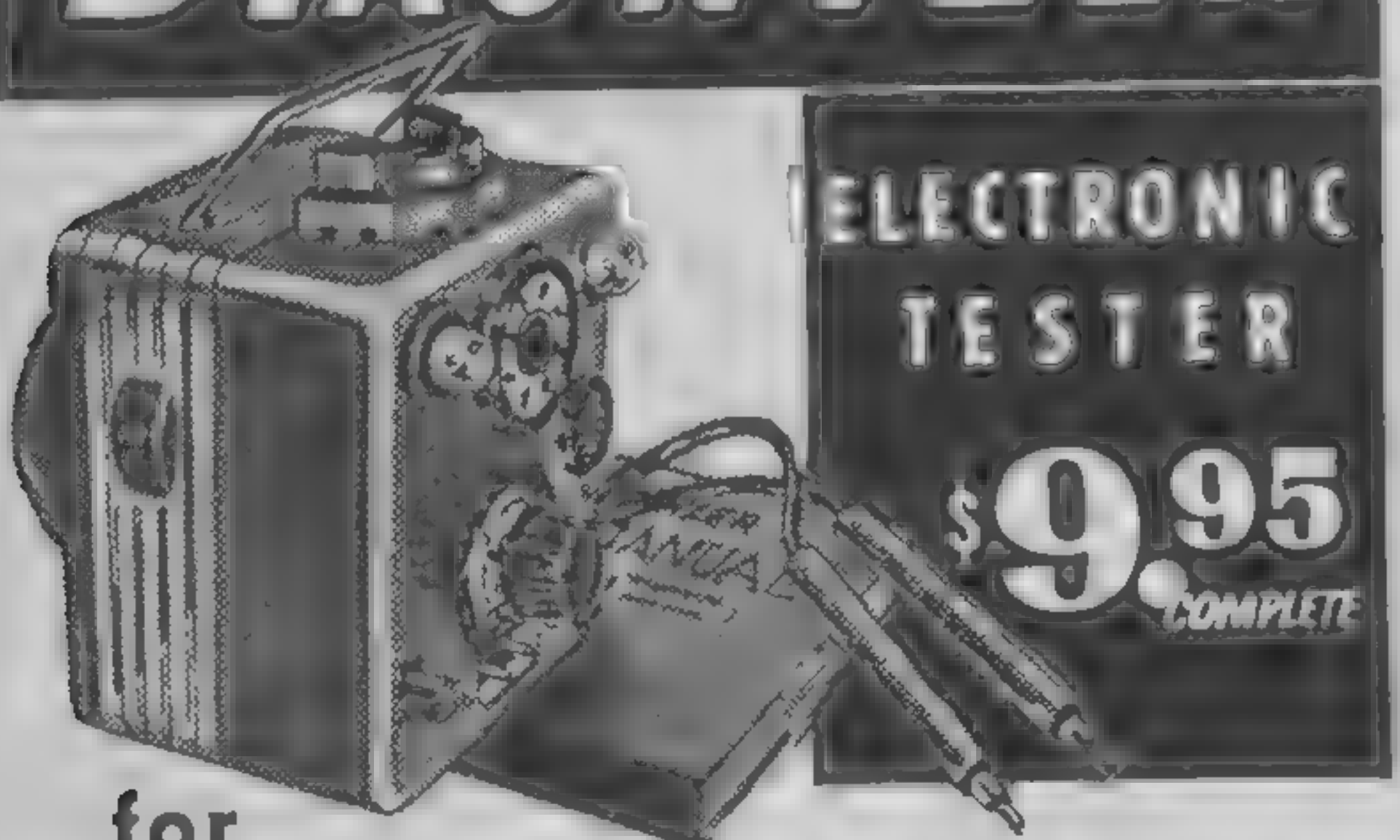
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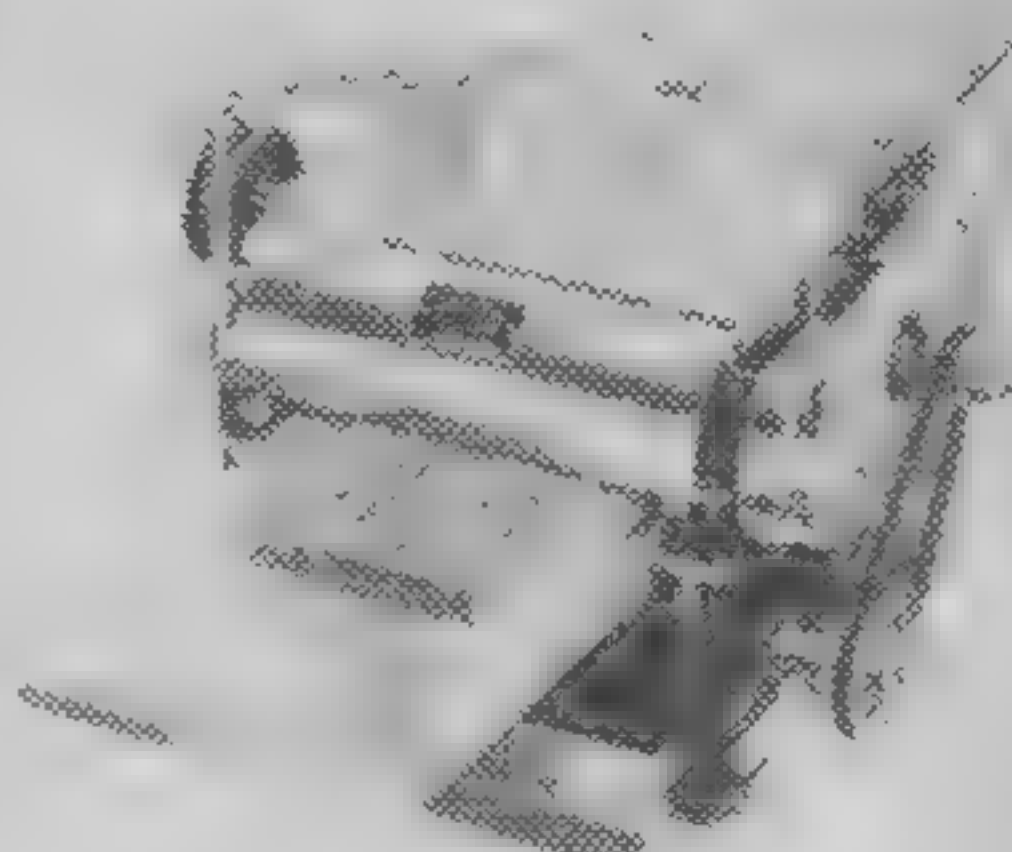
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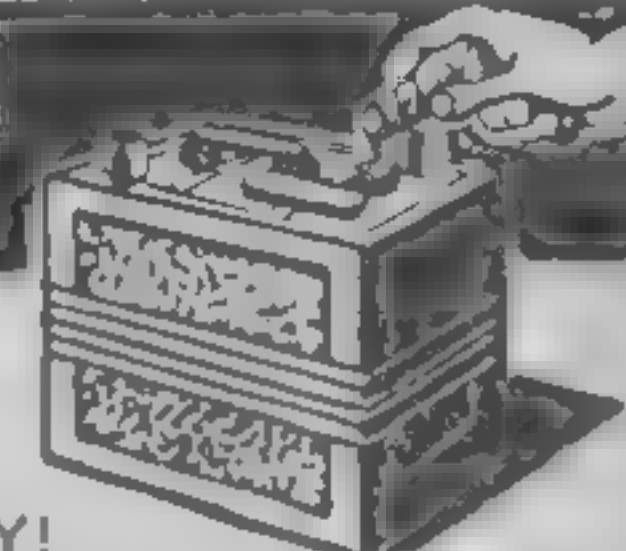
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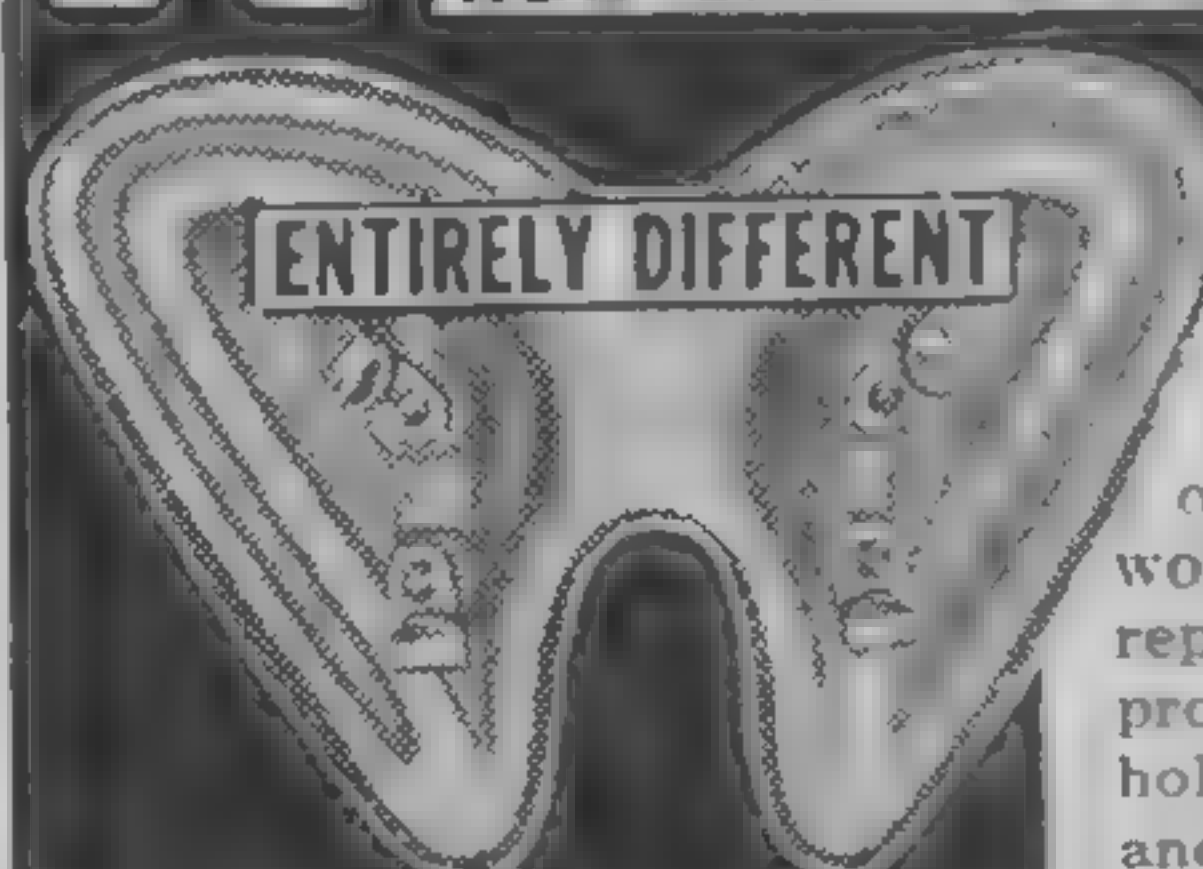


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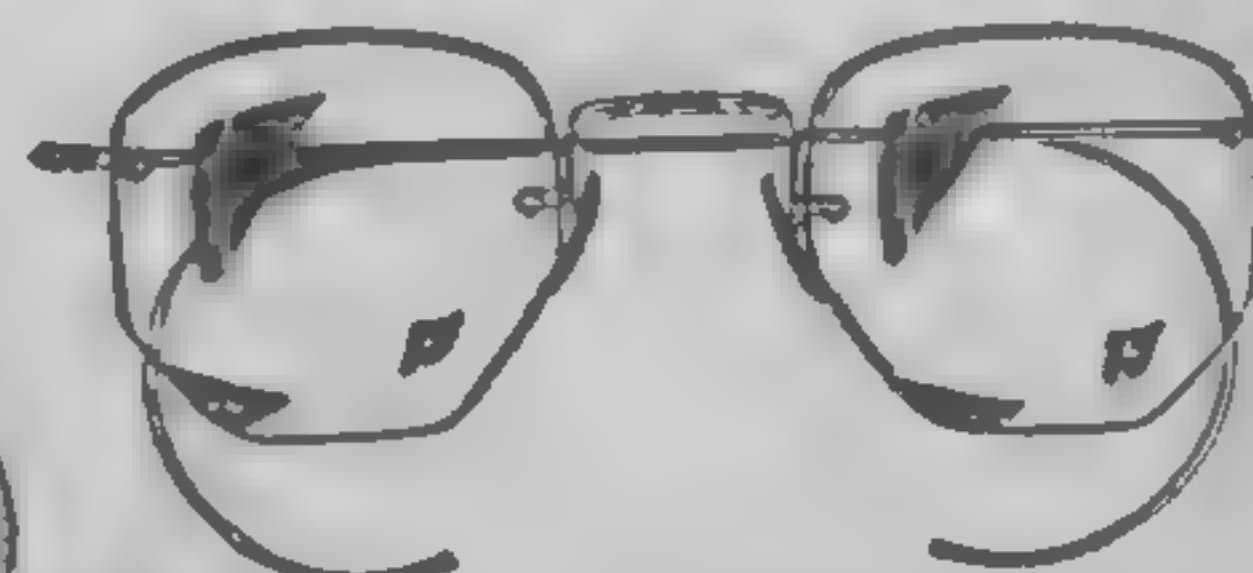
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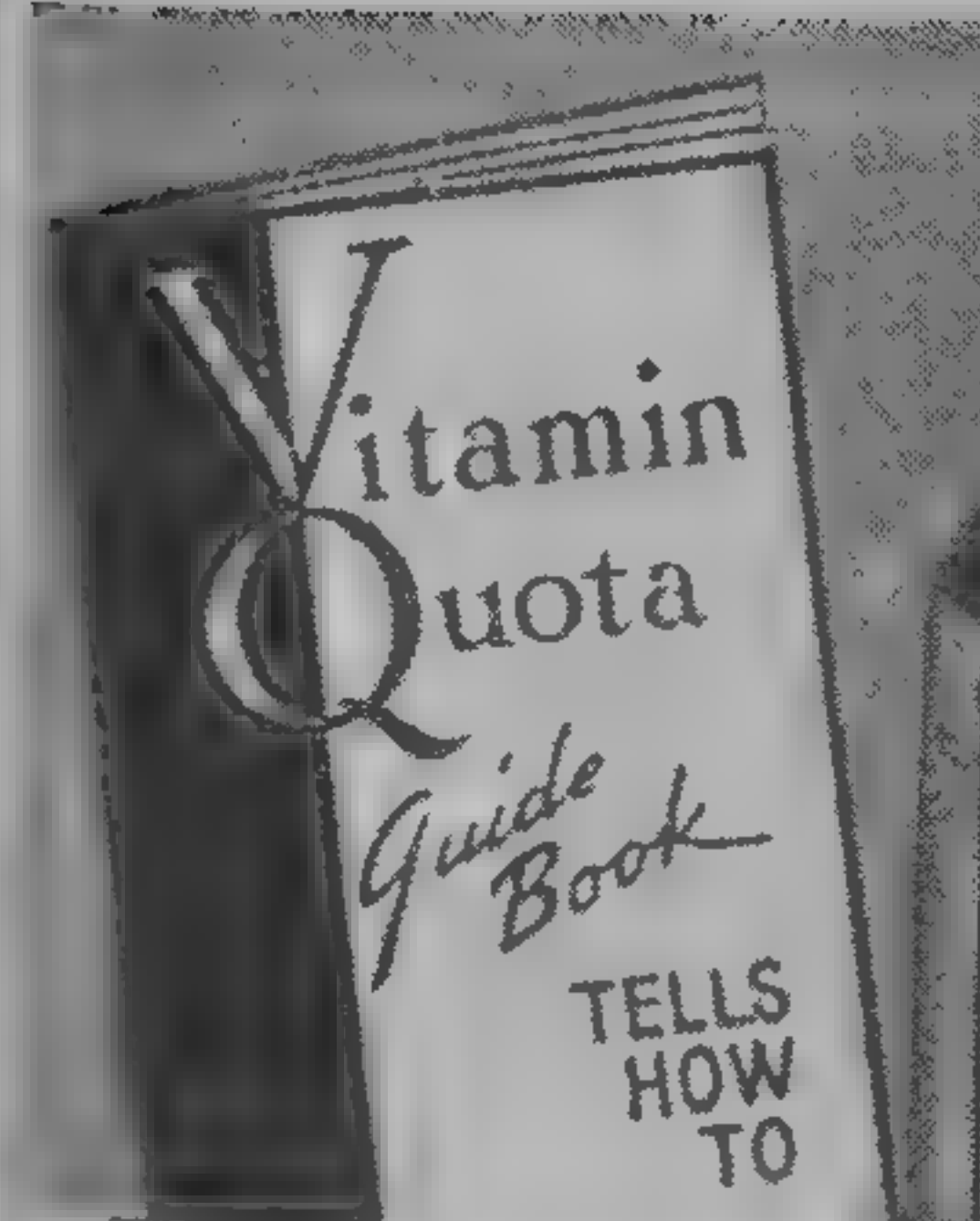


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All we ask in return is your good-will and word of mouth advertising if you like the pipe. Remember, the risk is ours, you can't lose. Sorry, only 1 Demonstrator to a family on this non-profit transaction. Good in the U. S. A. only.) PIPE 2/3 ACTUAL SIZE

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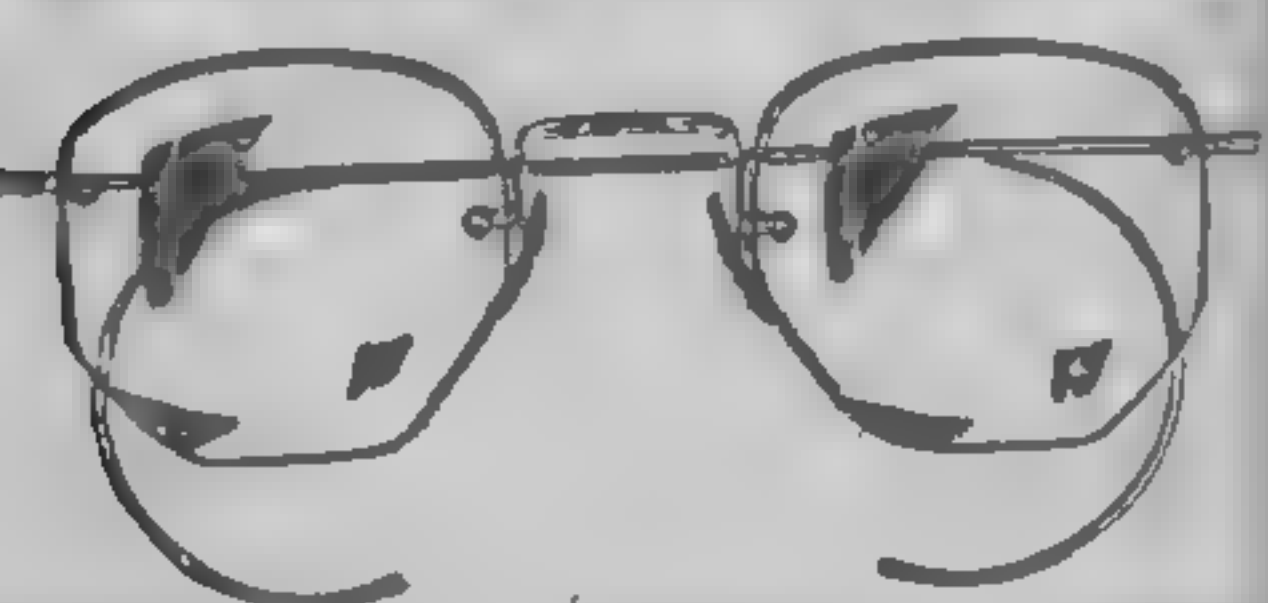
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Breaking in a new pipe is usually torture,
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all that. A nut sweet cake, specially built
into the genuine imported briar bowl, makes
this mellow beauty break in like a dream.
You'll get dry, clean, sludge-free smoking,
because the special construction of this won-
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Smoke Control — Combustion, Condensation
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We've set aside a limited quantity of these
imported briar beauties as Demonstrators.
The bowls are "slight seconds" taken out of
the regular production line before final
smoothing and polishing, but they're guaran-
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quality \$2.95 model.

Because we want to make new friends
for this sensational new kind of briar
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Demonstrators. Send us nothing for the pipe.
Please send 25¢ to cover postage and
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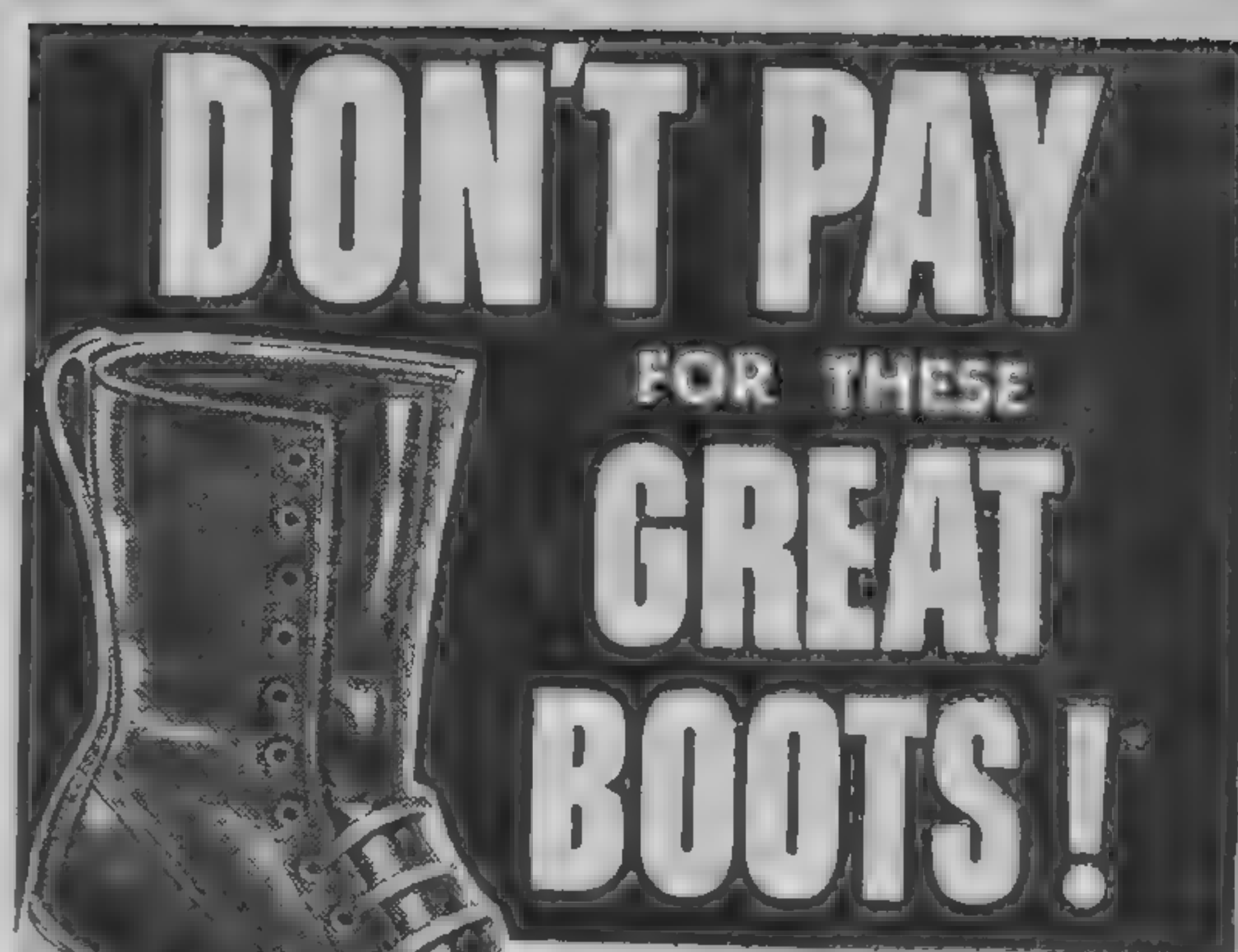
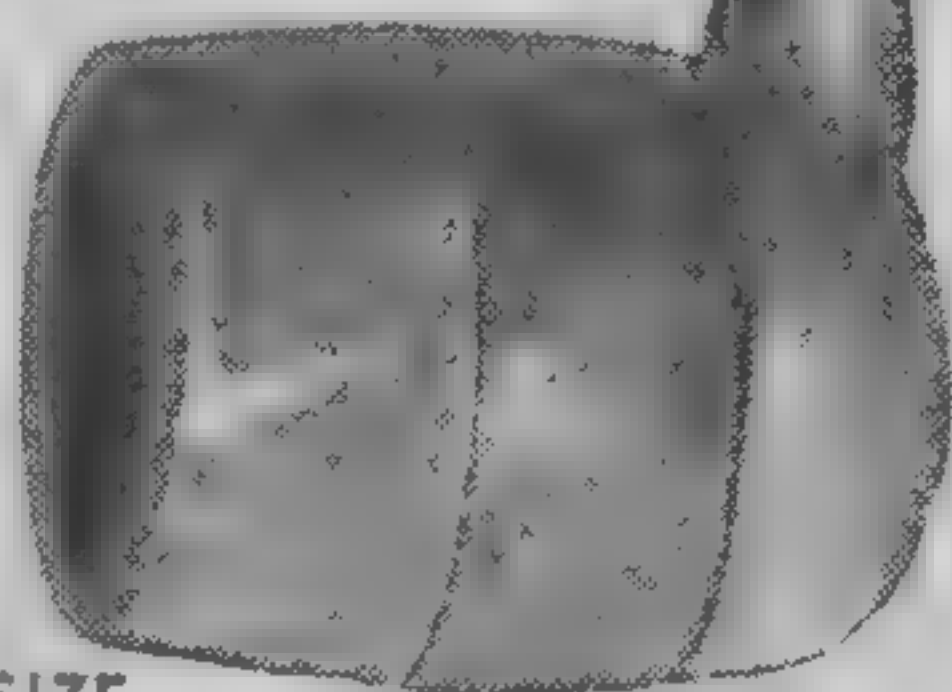
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Air Cushioned
Storm Seal'd Boot,
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Simple 2-finger demonstration of patented AIR CUSHION
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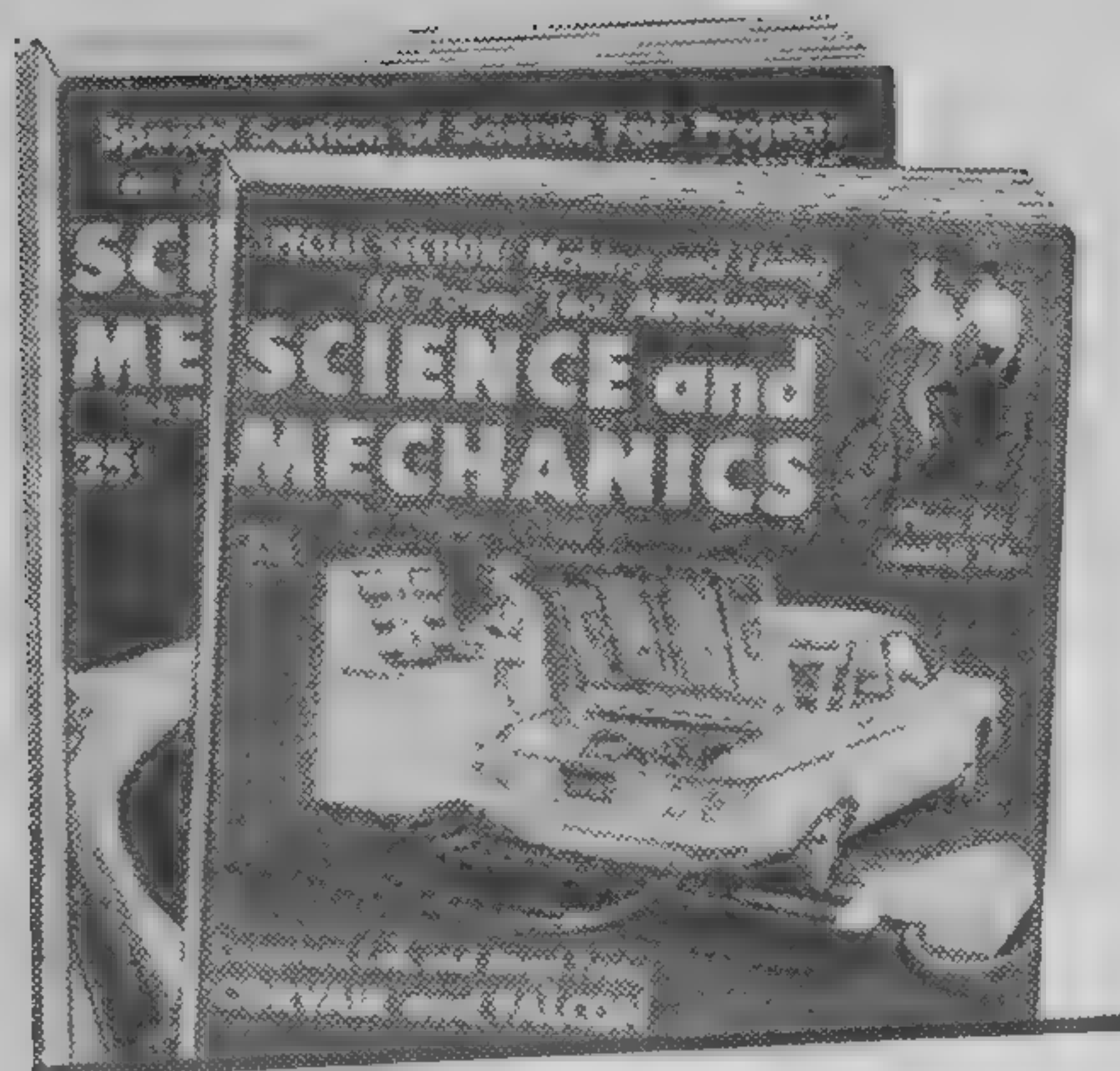
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The NEW SCIENCE and MECHANICS

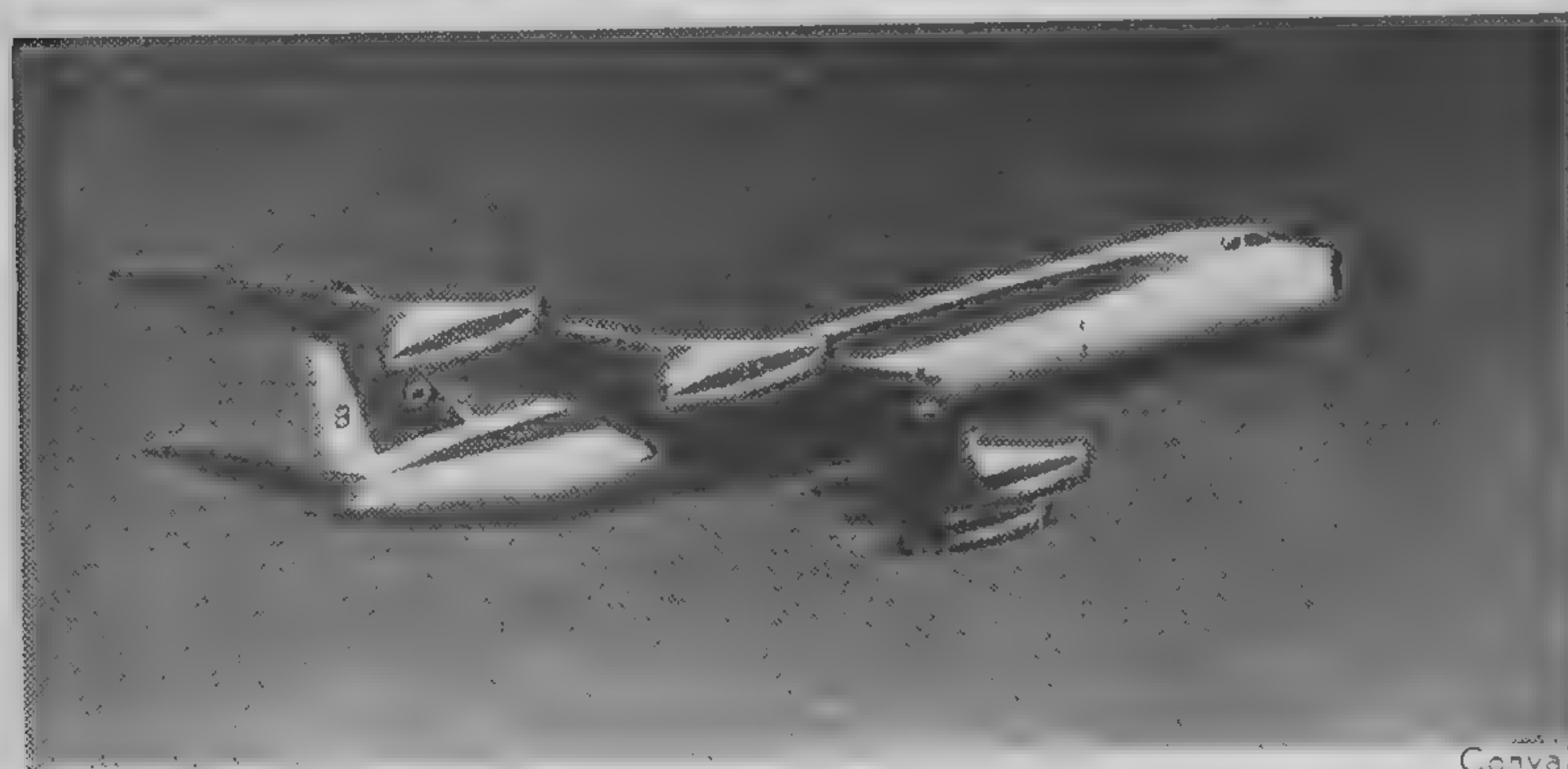
proves that
magazines change, too



United Air Lines

1920

First U.S. cabin pas-
senger plane, a con-
verted de Havilland



Convair

1960

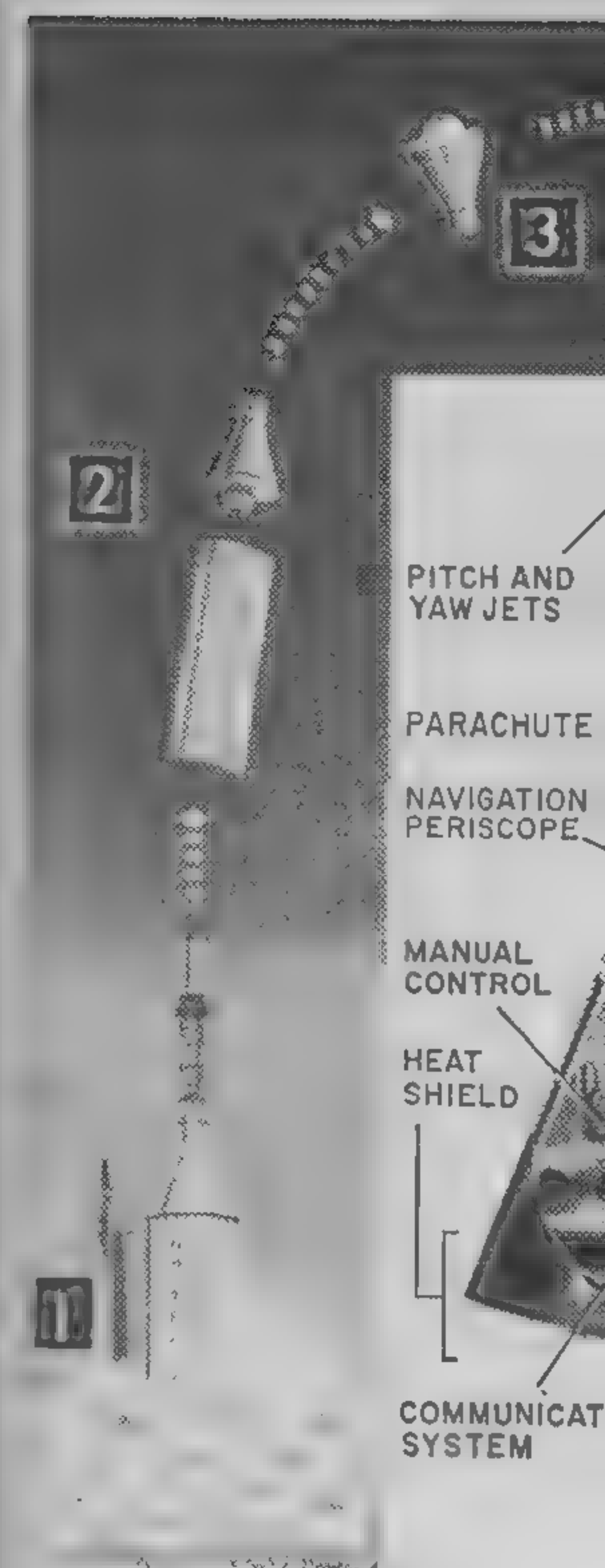
Newest U.S. pas-
senger jet transport,
the Convair 880

Science and Mechanics has always been a leader in its field—readers' mail tells us it's *the* leader—but beginning with the April issue, S&M (now a Davis Publication) is going to be even better, and it's going to be bigger than ever before. (With the October issue, we go monthly; a new issue, every month.)

The NEW *Science and Mechanics* will have the same solid substance, the same respect for facts it's always had. As before, you'll find the latest news on science and industry written to relate to your interests. You'll find completely detailed do-it- and make-it-yourself articles (in many instances on projects readers have asked us to cover). But there will be more editorial content than ever before and it will be

presented in new, more entertaining and more attractive ways . . . And in every issue of the NEW S&M you'll find an extra, added attraction: our special BONUS feature. (Sorry, right now we're guarding the subjects of this bonus series as we would our lives—or nearly so.)

For one of the most interesting experiences of your magazine-reading life, get a copy of the NEW S&M at your local newsstand; the April issue goes on sale March 1. Better yet, subscribe now to the NEW S&M—at the OLD subscription rates! To take advantage of this special offer, see the LAST CHANCE postcard inserted between pages 154 and 155 of this issue. Mail it today!



How S Back

WHEN scientists saw the Project Mercury capsule splash down in the Atlantic Ocean last year—shortly after it had traveled 100 miles into space—their proof that a man could survive a trip.

The capsule, a test model of which a man *will* ride, came back the trip unscathed after undergoing rigorous heat conditions and forces on its reentry into the atmosphere.

Navy Lt. Comdr. Alan B. Shepard, one of the seven astronauts trained to make the space trip, commented after seeing the capsule test that if he had his space suit with him, he would have gone on the trip.

NEW SCIENCE and MECHANICS

that
change, too

1920

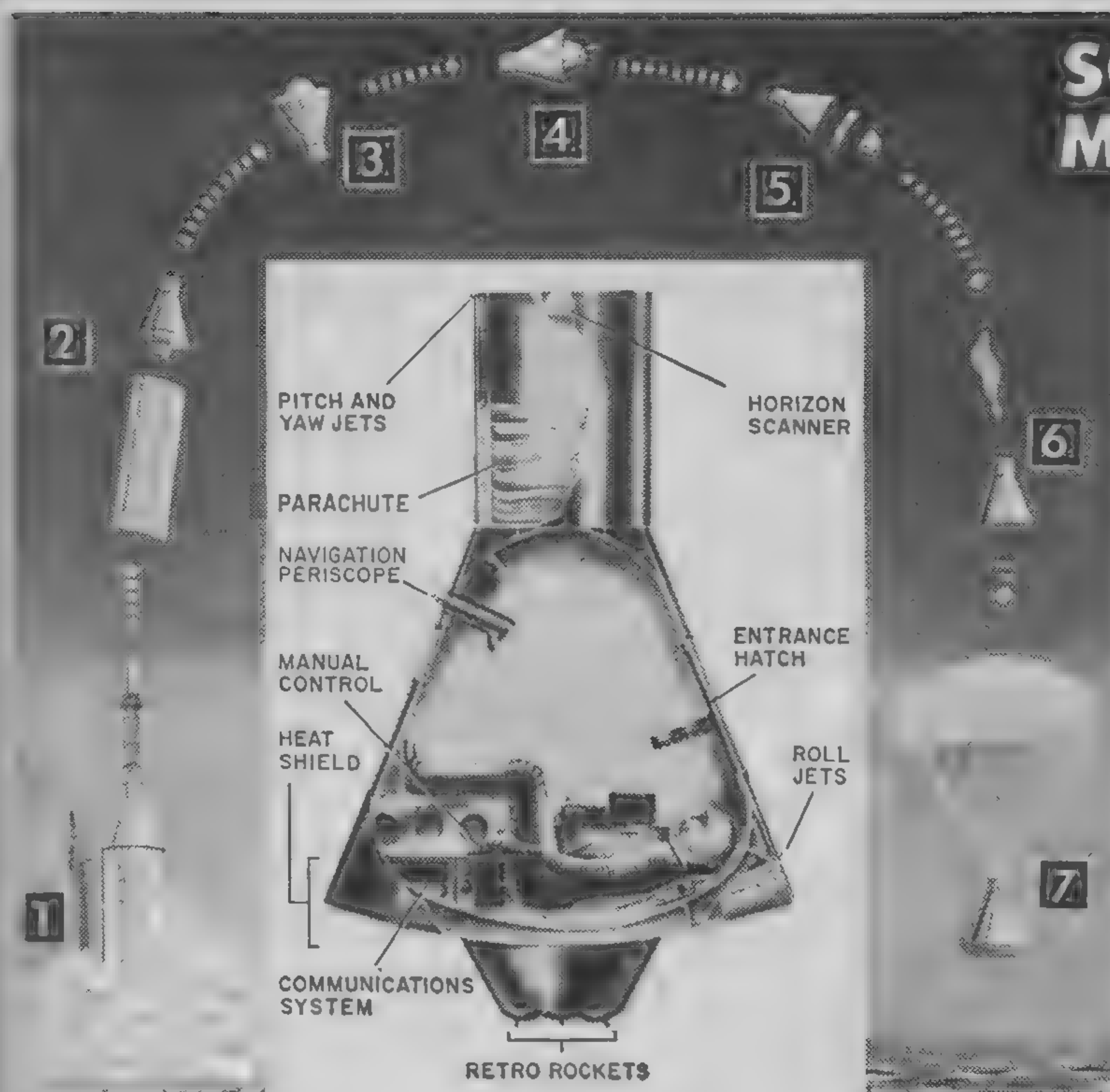
First U.S. cabin pas-
senger plane, a con-
verted de Havilland

1960

Newest U.S. pas-
senger jet transport,
the Convair 880

entertaining and more attrac-
every issue of the NEW S&M
added attraction: our special
erry, right now we're guarding
nus series as we would our lives

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ges 154 and 155 of this issue



SCIENCE and MECHANICS

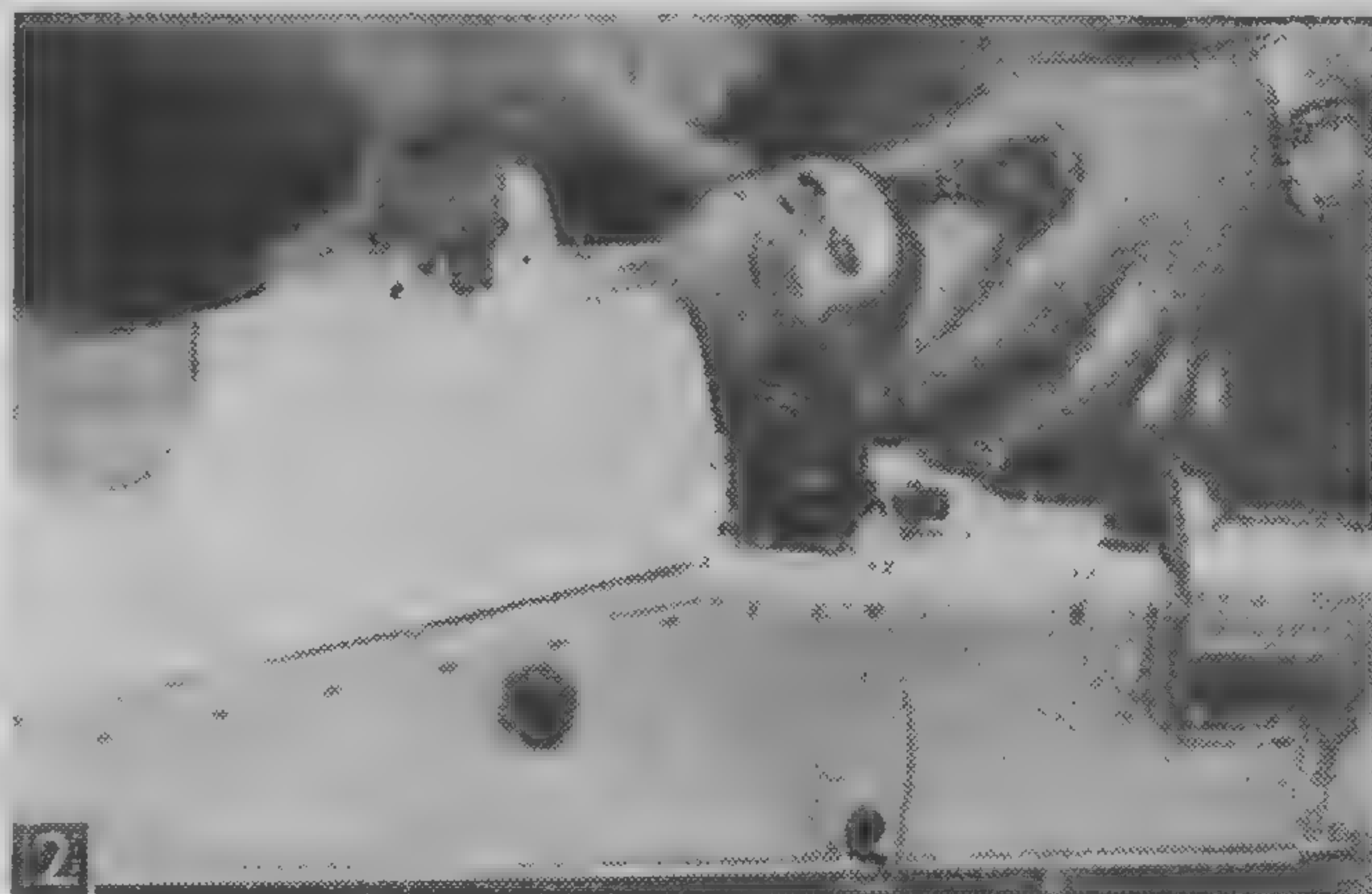
Drawing in center shows cutaway of Project Mercury capsule. Its flight sequence is visualized in drawings around it: (1) Capsule launched atop Atlas I.C.B.M. missile; (2) After escape rockets in tower have separated, five seconds after staging, the capsule separates from booster; (3) Capsule flips 180° so that heat-shielded blunt end will be forward on reentry; (4) Retro-rockets are fired to brake speed of descent; (5) First retro-rockets, then heat shield separates from capsule; (6) Drag parachute deploys, and (7) Landing parachute deploys and landing bag inflates. First passenger to ride in a Mercury capsule was a 7-lb. monkey named Sam, who rocketed 55 miles up last December in a successful test of the emergency escape system.

How Science Brings Them Back from Outer Space

WHEN scientists scooped a Project Mercury capsule out of the Atlantic Ocean late last year—shortly after it had soared 50 miles into space—they found proof that a man could survive such a trip.

The capsule, a test model of one in which a man *will* ride, came through the trip unscathed after undergoing rigorous heat conditions and gravity forces on its reentry into Earth's atmosphere.

Navy Lt. Comdr. Alan B. Shephard, one of the seven astronauts being named to make the space journey, jokingly commented after watching the capsule test that if he had had his space suit with him, he would have gone on the trip.



Monkey Able, an American-born rhesus, grins as she is released from life support capsule in which she rode Jupiter nose cone. Able and another monkey, Baker, underwent remarkably little physiological change during flight through space.



This is route first American astronaut will travel. Mercury capsule will blast off from Cape Canaveral, go into orbit and make three trips around the Earth at an altitude of about 100 miles. After about 4½ hours, capsule will land in Atlantic Ocean near the Bahamas.

Shephard was seconded by Charles W. Mathews, chief of the operations division for the National Aeronautics and Space Administration's Space Task Group. Mathews said bluntly that a human passenger could have survived the test shot.

This does not mean that Shephard or one of his fellow astronauts will be rocketed into space next week, next month or even later this year. Getting any object—especially a living creature—out into space and getting it back again safely poses vast problems for the space scientists.

Basic Problems. Blasting off into space, as everyone knows, simply involves getting together enough push (thrust) or explosive power to lift the desired weight to the desired speed—along, of course, with a suitable guidance system to keep the rocket on course. And, because nobody (except possibly the Russians) has any thrust to spare, the takeoff accelerations are relatively slow, probably not exceeding 12 to 15 Gs (12 to 15 times the pull of gravity). This would certainly not injure a healthy passenger, unless sustained for, say, 10 seconds; and, while uncomfortable, it will likely not even cause blackout to the carefully-selected astronauts, what with pressure suits, heavily cushioned couches and the like.

The return trip to Earth, at the violent speeds of the little-known yonder, presents a much different picture. The ground is mighty hard. So also is water, as you well know if you have ever made a belly-flop dive from even a modestly high diving board. And so, too, is the Earth's atmosphere, if you plunge into it at really great speed. G forces involved here can be tremendous. For deceleration (slow-down) is exactly the same thing as acceleration (speed-up) in terms of its crushing pressures upon the body.

Specifically, a nose cone or satellite entering the outer fringes of the atmosphere at about 300,000 feet altitude and at anything close to orbital velocity (above 17,500 mph) would slow down at a rate inducing a force of about 60 Gs. This deceleration, resulting from friction of the atmosphere, increasing as the air becomes denser as the object descends, approximately equals the



One of four early high-altitude, high-speed units for testing chutes, the Cree missile would spew out three separate chute-carrying subsidiary rockets at heights to 150,000 feet and speeds to 3040 mph.

effects of crashing two automobiles head-on at 45 to 50 mph. If you were in that vehicle, strapped in and tightly restricted (as you would be in a nose cone or satellite), that 60 Gs is plenty of force to crush you simply by the weight of your own body.

At the same time, as you descended through the atmosphere, the friction that slowed you so abruptly would also generate heat so intense that your nose cone or space capsule would glow, frying you if you weren't protected from it.

The problem, then, resolves to one of slowing the capsule gently and providing for heat dissipation so that both the capsule and the astronaut riding in it will come through the journey safely.

To get a better picture of the problem, let us for a moment move ahead in time—to next year or the year after—and take a look at the first manned Project Mercury flight.

The astronaut will be strapped into a capsule (see Fig. 1) which will be launched into space atop an Atlas I.C.B.M. fired from Cape Canaveral, Fla. At about 60-miles altitude over the Atlantic Ocean, the missile booster engines will burn out and drop off, and the capsule will continue in a great, upward-curving arc. The speed required to place it in orbit will be reached at an altitude of about 115 miles, where small rockets—fired automatically—will separate the capsule from the rocket.

The capsule will then be flipped 180°, to place its blunt end forward. Jets of gas, fired in response to an auto-pilot, will keep the capsule right side up. After three circuits of the Earth (see Fig. 3), when the capsule is just north of

Hawaii, a ground station will fire a series of rockets mounted on the capsule. The force of these rockets will slow the capsule's motion, slowing it to about 100 mph and causing it to re-enter the Earth's atmosphere near the Bahamas.

This final stage of the mission must be slowed to about 100 mph. This is what has given scientists the name "come-and-get-me" radio.

Hidden Answers. The answers existed in almost all the first serious talk of space began.

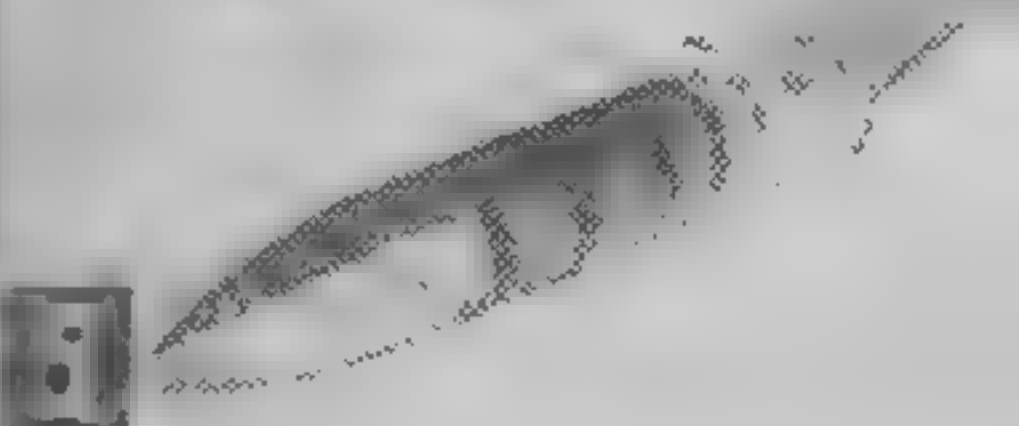
When the first Sputnik was launched, it itself far behind in many respects, its fuels and guidance systems were primitive.

In contrast, when the first man returned an object to Earth, it was respected among scientists and the general public, was a job, but to do it quickly. It was a job, to do it with 100% accuracy, but some little things had already been done.

Soon after World War II, the problems of a pilot flying at high speeds. They had no body could stand and come down safely. Thus, at the time, the Force Base in the dry, the now-famous rocket.

To decelerate the speed, slowed on ejection, the chutes such as had never been used then—young Cook Labs.

Cook's research team tested the chutes, in a variety of speeds. Cook's and open at rates none



First nose cone to be recovered intact, this Nike-Cajun nose cone was fired from Fort Churchill, Manitoba, at an altitude of 100 miles. Ribbon chute "come-and-get-me" radio. (ground) included flip-out antenna which opened at peak.

route first American astro-
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from Cape Canaveral, go
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the Earth at an altitude of
100 miles. After about 4½
capsule will land in Atlantic
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feet and speeds to 3040 mph.

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three circuits of the Earth
ne capsule is just north of

Hawaii, a ground station will trigger three retro-
rockets mounted on the blunt end of the capsule.
The force of these rockets will act against the
capsule's motion, slowing it down by some 350
mph and causing it drop out of orbit, re-enter
the Earth's atmosphere and drop into the Atlan-
tic near the Bahamas.

This final stage of the flight, when the capsule
must be slowed to bring it safely back to Earth,
is what has given scientists the most trouble.

Hidden Answers. Happily, many of the an-
swers existed in almost ready-made form when
the first serious talk of sending a man into space
began.

When the first Sputnik went up, the U. S. found
itself far behind in matters of rocket engines and
fuels and guidance systems.

In contrast, when the call went out for a sys-
tem to return an object from space, a firm highly
respected among scientists but little known to
the general public, was not only ready to do the
job, but to do it quickly—and what is more amaz-
ing, to do it with 100% success. It was almost an
accident, but some little of the needed research
had already been done by Cook Research Labora-
tories, a division of Cook Electric Co. of Chicago.

Soon after World War II, as U. S. jet planes
began to appear, the Air Force had to face the
problems of a pilot forced to bail out at very
high speeds. They had to know what G forces a
body could stand and how it could be slowed
down safely. Thus, at the mammoth Edwards Air
Force Base in the dry lake area of California,
the now-famous rocket sled was built.

To decelerate the sled, as a pilot would be
slowed on ejection, parachutes were needed,
chutes such as had never been built before. The
then-young Cook Labs was hired to do the job.

Cook's research team designed and built and
tested the chutes, in all shapes and sizes and at
a variety of speeds. Chutes that would pop out
and open at rates none had been asked to before;



First nose cone to be recovered with cameras and film
intact, this Nike-Cajun nose landed March 24, 1958,
near Fort Churchill, Manitoba, after reaching 73.6
miles altitude. Ribbon chute had built-in antenna for
"come-and-get-me" radio. Recovery system (fore-
ground) included flip-out metal dive brakes which
opened at peak of trajectory.



Nose cone of Jupiter missile which carried monkeys
Able and Baker to altitude of 300 miles on 1500-mile
flight is hoisted aboard Navy recovery ship Kiowa.
Floating cone was recovered by Navy underwater
demolition teams.



Boilerplate model of Project Mercury space capsule
shown aboard USS Strong after being recovered.
Opening at top of capsule contained recovery system
during flight. It opened to deploy drag parachute
which slowed capsule after reentry and the large
parachute that lowered capsule to the water.

tubular and conical and square and triangular
as well as the familiar umbrellas; chutes with
panels deliberately cut out, drags of trailing
streamers and canopies made from ribbons rather
than from solid panels. They ranged from one
foot to 88 feet in diameter. In tests, the scientists
got the answers to high-speed deceleration, up
to speeds of Mach 3.5.

Aided in IGY. Thus, it was natural that when
the International Geophysical Year began, Cook
was again called upon to help bring back in
one piece rocket-borne instruments from high-

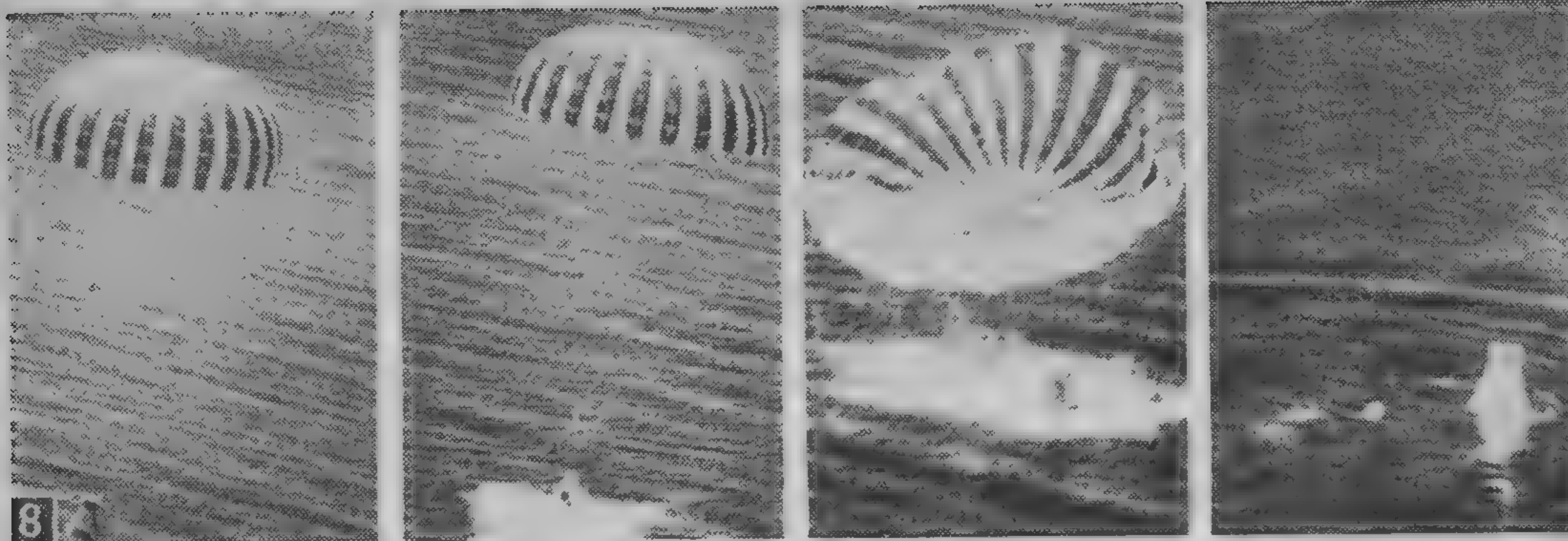


Photo sequence shows full-scale drop test capsule descending into Salton Sea from 30,000-foot altitude. Released from Air Force cargo plane, the test capsule—weighing one ton—was successfully recovered.



Saucer-shaped beryllium disc is removed from die after being forged on 50,000-ton press. After machining, the finished piece—47 inches in diameter and 1 inch thick—forms space capsule's heat shield.

altitude probes. Further to test its chutes and control devices, Cook built some of its own rockets: Skokie I, a high sub-sonic missile; Skokie II, a transonic and supersonic device; Cree, a "three-shot" booster (see Fig. 4), and Cherokee, a missile which ejected a fully instrumented pilot's seat in flight and returned it to Earth.

Thus armed, Cook entered the IGY rocket program at Fort Churchill, Manitoba, Canada, in which more than 50 probe rockets were fired with instruments to study the aurora borealis, the Earth's magnetic field and other phenomena, perhaps our most successful rocket program to date on the basis of firing results.

Here, the research team developed the "recovery package" concept, in which a single package of devices would slow the rocket nose cone, let it down gently and then start sending out radio signals by which it could be found.

Specifically, this package consisted of metal dive brakes which flipped out at the peak of the rocket trajectory, when explosive bolts separated the nose cone from its booster, followed by parachute deployment at proper altitude, after which

the "come-and-get-me" signals began. This program culminated with the recovery undamaged of cameras and the pictures they had taken from a Nike-Cajun nose cone near Fort Churchill (see Fig. 5). But meanwhile, the really big packages were developing elsewhere.

Getting a Nose Cone Back. Obviously, no nose cone—which can be translated "warhead" in a military missile—will do much good if it burns up coming back to Earth. In 1957, U. S. Intelligence knew the Russians were firing long-range missiles. We had to know that ours were potentially effective. To prove it, we had to recover a nose cone intact. A new Cook recovery package went into the works, but fast.

Finally, one night in August, 1957, scientists in a firing blockhouse at Cape Canaveral watched the dying gleam of the rockets of a Jupiter C disappear among the Southeastern stars.

Fifteen hundred miles away down the Atlantic range, Navy demolition expert and skin diver Lt. Robert K. Asman leaned across the rail of the USS *Escape*, hove to in a triangular formation with two destroyers. He had heard the countdown. Now the range observation stations cracked on the radio, each in turn: "Bird on schedule, on course."

A moment later, three slowly separating meteors, first orange, then white hot, burst into view—the booster and guidance packages, both now separated, and the nose cone itself, seemingly hundreds of miles above. As the others went on, the nose cone curved downward toward the target triangle, grew brighter, then began to dim, for things were happening up there.

High above the Earth, activated by a barometric trigger, the recovery sequence was beginning. First, the metal back plate of the recovery package, at the rear of the nose cone, blew off. Out popped a billow of streamers as the cone began to slow. Gently these formed into a ribbon umbrella. Next a balloon popped out, was quickly inflated by bottled gas and trailed behind on a cable. About then, the nose cone struck the water, its impact largely taken up by the chutes.

As the cone settled into the water, the balloon took up the slack in the cable, holding it float-

ing below the surface.

Now, from a pool atop the balloon, the tenna of a tiny radio transmitter sprang right and began transmitting beeps for radio homing. Underwater dye markers were released (and, in later packages, shark repellent as well, although in this first one). Also underwater, a second homing device began transmitting sound impulses on which Navy listening devices could zero in.

One of the destroyers swung alongside in minutes, quickly followed the *Escape*. Lieutenant Asman and his crew went over the side, sharks or no sharks, fastened a hawser, and the nose cone came aboard. This was the nose cone shown to a national television audience by President Eisenhower.

And shortly thereafter the second and third recovered the same type system.

Enter the Monks. The package functioning with the monks turned to the next man in space—a missile with live passengers. Full-scale in use (the first had but the recovery package tactical.

In the small morning yet another Jupiter took its way 300 miles into the air. Lt. (jg) R. Edward Foy was the nose cone aboard the *Escape*, away, off the coast of Florida. Keys Able and Baker were couches alive and well, surely as the day Collier another island not far.

The experiment was the monkeys had been subjected of a second, about the first astronaut will beats and respirations change during the flight, mally 130 to 280 per minute flight to 222 on impact physiological changes a small. (Able died a few operation to remove an der the skin, but an a



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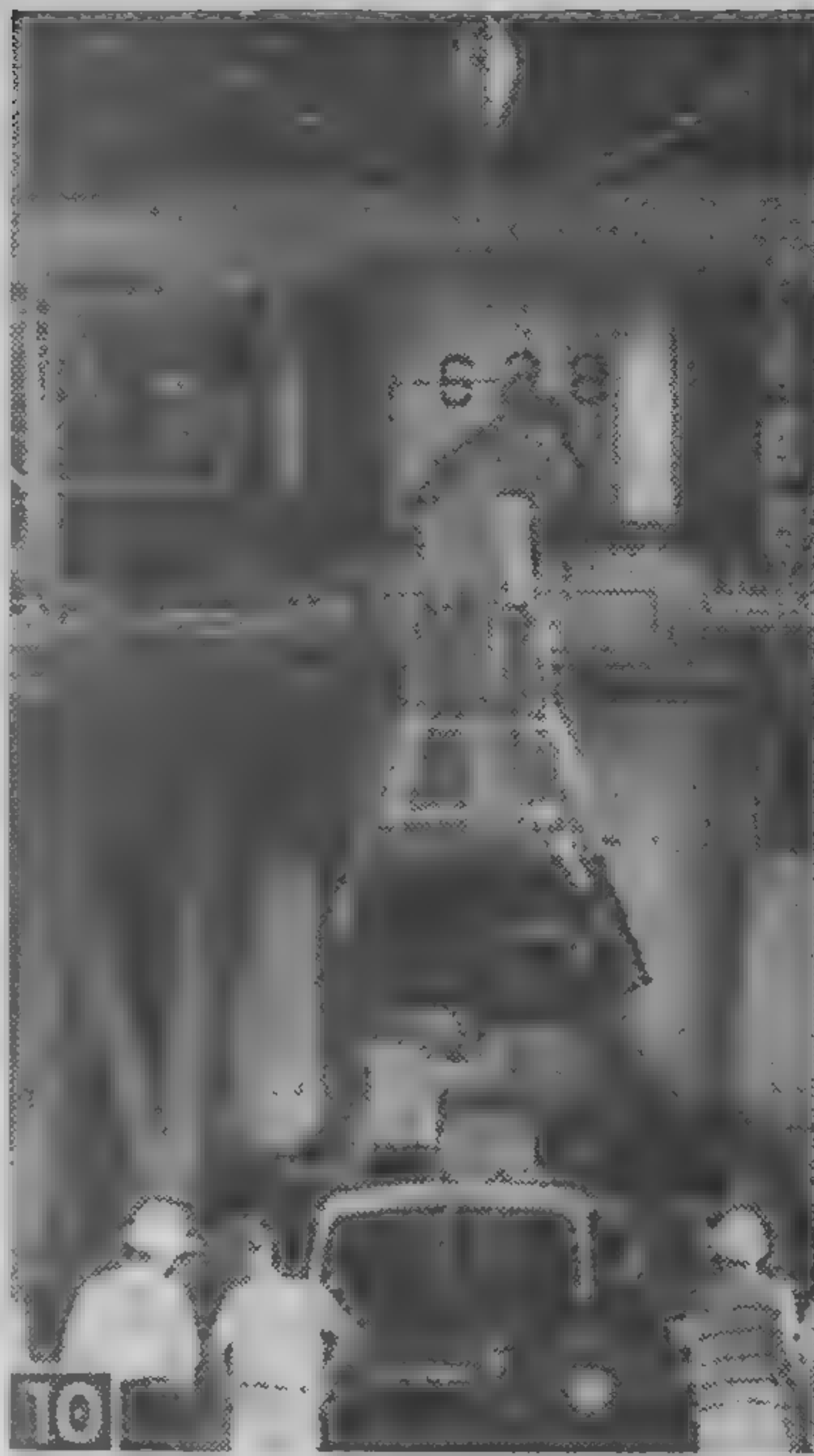
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And shortly thereafter, second and third recoveries of nose cones with the same type system went off on schedule.

Enter the Monks. With the Cook recovery package functioning without failure, the scientists turned to the next step toward putting a man in space—a missile firing and recovery with live passengers. Full-sized nose cones were now in use (the first had been a 300-lb. miniature), but the recovery packages remained almost identical.

In the small morning hours of May 28, 1959, yet another Jupiter took off from the Cape, on its way 300 miles into space. This time, it was Lt. (jg) R. Edward Foy and his crew who hauled the nose cone aboard the *USS Kiowa*, 1500 miles away, off the coast of Antigua. And when monkeys Able and Baker were lifted from their couches alive and well, history was made as surely as the day Columbus stepped ashore on another island not far away (see Figs. 2, 6).

The experiment was a complete success. The monkeys had been subjected to 38 Gs for a fraction of a second, about three times as much as the first astronaut will undergo, yet their heartbeats and respirations showed amazingly little change during the flight. Able's heartbeat, normally 130 to 280 per minute, varied from 134 during flight to 222 on impact with the water. Baker's physiological changes also were extraordinarily small. (Able died a few days later during an operation to remove an electrode implanted under the skin, but an autopsy showed its death



Side view of boilerplate test model of space capsule shows curve of heat shield which will absorb the brunt of heat on reentry into Earth's atmosphere. Behind the model is the base of its Atlas booster.



Atlas ICBM carrying Big Joe capsule roars off launching pad. Big Joe is a boilerplate model of manned orbital capsule, which scientists can study for effect of reentry heat and other flight stresses.

was not of causes related to its space flight.)

Solving the Heat Problem. Other scientists, meantime, were working on a space capsule configuration which would withstand any known combination of heat loads, acceleration and aerodynamic forces that could occur at blastoff or reentry.

What finally evolved were plans for the blunt nosed capsule shown in Fig. 1. In January of last year, the NASA named the McDonnell Aircraft Corp., of St. Louis, Mo., as prime contractor for such a capsule.

It has double walls of titanium, inside a heat protection vessel. A beryllium heat shield, shaped like a broad, shallow dish, is attached to the blunt forward end and lined with several inches of fiber glass-resin compound. About a fifth the weight of steel, beryllium has an unusual capacity for absorbing large quantities of heat (see Figs. 9, 10). During the first stages of flight—from launching pad to outer space—the beryllium heat shield will form the outside covering of the capsule's "floor." On return to Earth, after the capsule has rotated 180°, the wide, blunt shield will be the chamber's leading face and will store and dissipate the heat of reentry.

The fiber glass-resin compound provides another heat barrier, through planned, controlled deterioration of the surface into gases and molten liquids under the influence of intense heat. The heat is drawn off, dissipated away from the capsule by a melting and stripping off process.

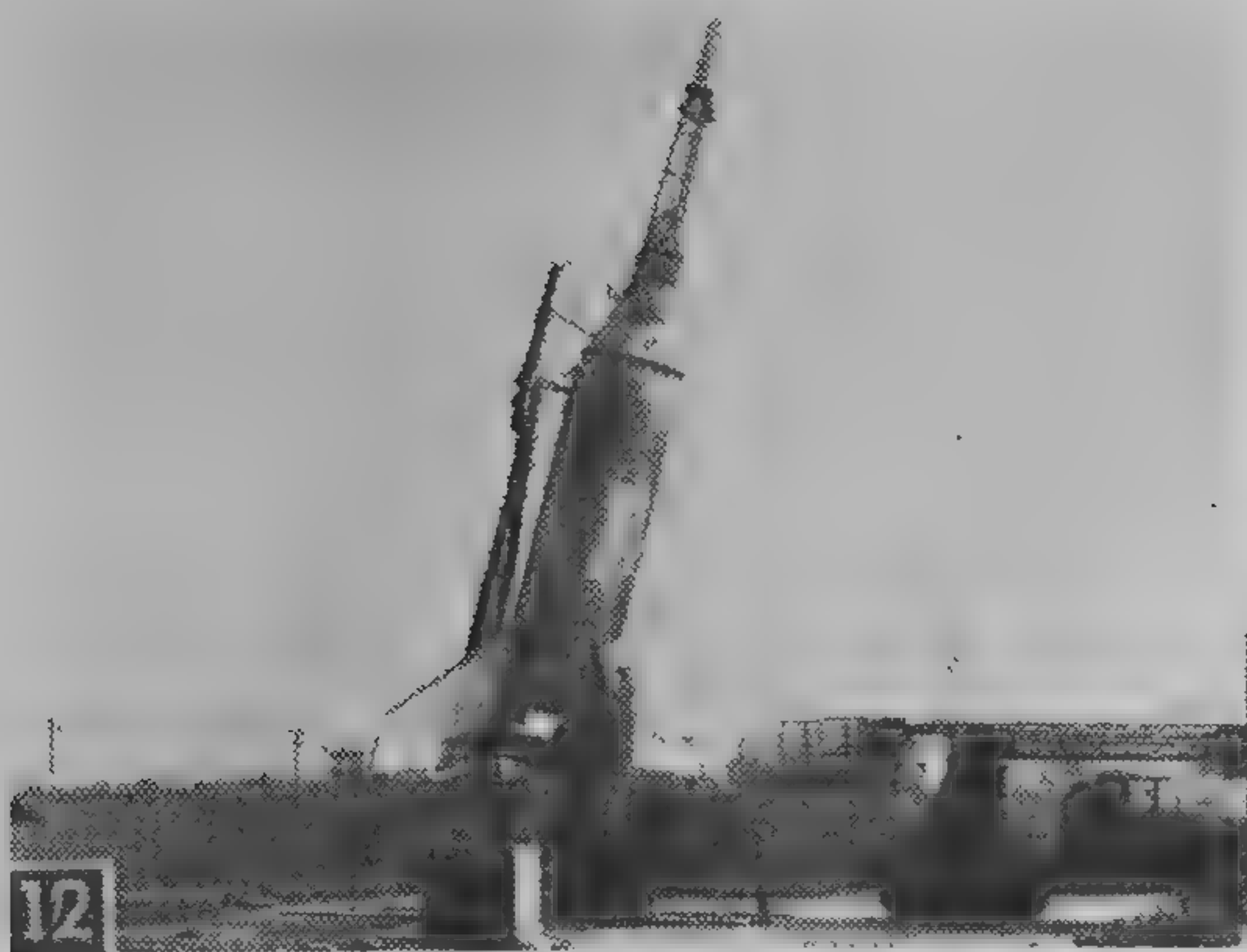


Photo shows Little Joe booster, used in operational test of the booster launching and destruct system. On top of booster is boilerplate capsule model, with inert escape rocket system in tower above it.

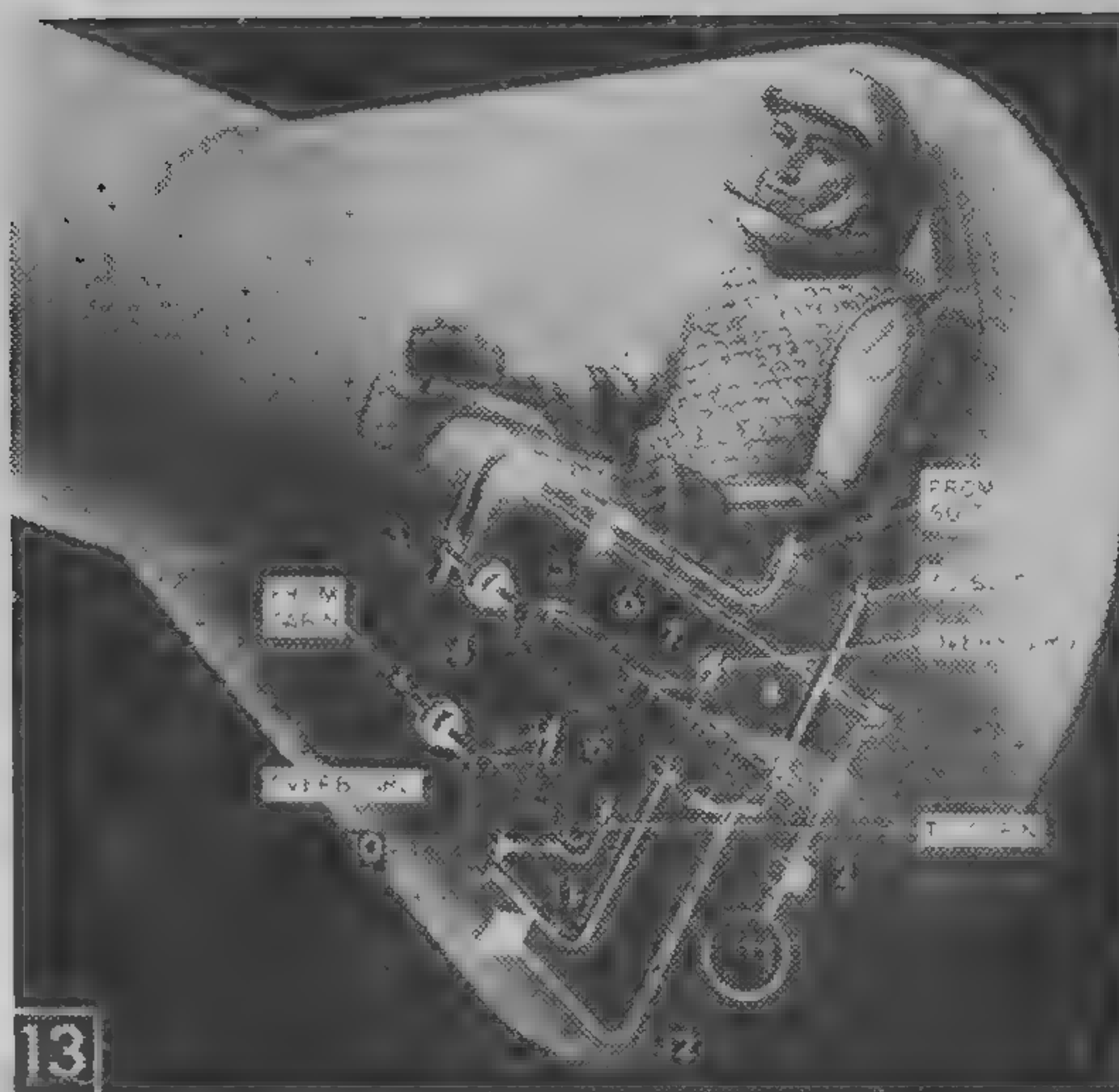
In September, 1959, Lt. Comdr. Shepherd and NASA scientists watched as a full-scale boilerplate model of the Mercury capsule—complete with heat shield—was boosted 100 miles into space atop an Atlas launched from Cape Canaveral (see Fig. 11). The capsule re-entered the atmosphere at 250,000-foot altitude, traveling 14,000 *mph* and was recovered after landing in the ocean (see Fig. 7). Because of a malfunction during launching, the Atlas did not drop its booster stage, causing the capsule to enter space a bit under the planned velocity of about 17,250 *mph*. This failure to follow the exact planned flight path meant that the capsule spent more time in the dense atmosphere and encountered a higher temperature than had been counted on, but for a shorter time.

The maximum temperature on the outside skin of the heat shield reached about 3000°F during the critical moments of reentry—50 to 30 miles above the Earth. And the resisting air just a few inches ahead of the plummeting capsule reached a temperature of close to 10,000°F for a few seconds.

But inside the capsule's pressure vessel—the area to be occupied by the astronaut, only inches away from the outer skin—the temperature stayed below 150°F during re-entry. During the rest of the trip, inside temperature was kept between 80 and 100 by an air conditioning system. The test was so successful that NASA cancelled a scheduled shoot that was to have duplicated the heat conditions caused accidentally by the malfunction.

If mechanical failure should occur during the launching of the first *manned* capsule, the capsule would be ejected automatically to safeguard the astronaut. For, in addition to the testing already described, an escape system also had been tested successfully.

In a November, 1959, test, a capsule was rocketed to an altitude of 35,000 feet. Escape rockets, located 16 feet above the capsule in a tower and



(1) Oxygen tank. (2) Pressure reducer. (3) Debris trap. (4) Fans. (5) Odor absorber. (6) Carbon dioxide absorber. (7) Filter. (8) Water absorber. (9) Heat exchangers. (10) Cooling tank. (11) Water lines. (12) Tank Pressure line.

Drawing shows space capsule's environmental system, developed by the Garrett Corp., Los Angeles, Calif. System provides oxygen both for space suit and interior of capsule.

activated 30 seconds after launch, carried the capsule several thousand feet from the booster (see Fig. 12). They burned for one second, then after a 20-second coasting period, were ejected. About 10 seconds later, the capsule's drag chute opened, and—at about 10,000 feet—the main chute opened, easing the capsule into the Atlantic Ocean at a speed of about 30 feet per second (About the same effect as a man jumping off a 14-foot-high wall).

Inside the Capsule. During manned flight, the astronaut will wear a pressurized flight suit as his life-support garment, and an environmental system will envelop him in an artificial atmosphere of oxygen, protecting him against the near-vacuum of space. It will have a 28-hour supply of oxygen for breathing purposes, cooling and pressurizing of the capsule and flight suit (see Fig. 13).

To test all the equipment—and the astronauts—before the first earth orbits are attempted, preliminary, sub-orbital flights will be made. In these, each of the seven astronauts now undergoing rigorous testing, conditioning and training will ride about 125 miles or so at 4000 *mph* in capsules boosted by Redstone missiles. During these flights, the men will experience weightlessness for about 5-minute periods.

Before an astronaut so much as gets lifted from a launching pad, however, monkeys and other animals will precede him every step of the way, from proving out the environmental control system to further checks on the effects of weightlessness and deceleration. For science is going all-out to insure that when that first man is rocketed into space, he'll come back down again in good shape.

Why
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Some

By JA

BEFORE you yell oil into his space better gander it surprise. Missing ar plugs, carburetor and The engine? It's Marc-10, a 7½-hp diesel sister 15 and 22-hp m to-coast controversy board owners argue t diesel power.

The diesel's advantage tion, its safety (diesel hazard than gasoline)

Its disadvantages a life and low-cost oper to pay a premium—in

Originally designed Defense contract for a to be backpacked by pulls its power from single cylinder.

At first glance, in f all cylinder—the sing the combustion cham sleeve. The manufac



View of top of air-cooled axial air-cooling fan, injected. With top shroud in place, it is a diesel is by the "D"



(1) Reducer. (3) Debris trap. (4) Carbon dioxide absorber. (7) Heat exchangers. (10) Cooling (12) Tank Pressure line.

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Why one manufacturer is gambling on boat owners paying more at first—and less later—for

Something New — Diesel Outboards

By JAMES JOSEPH

BEFORE you yell at that fellow pouring fuel oil into his spanking new outboard motor, better gander it up close. You'll be in for a surprise. Missing are such "essentials" as spark plugs, carburetor and magneto.

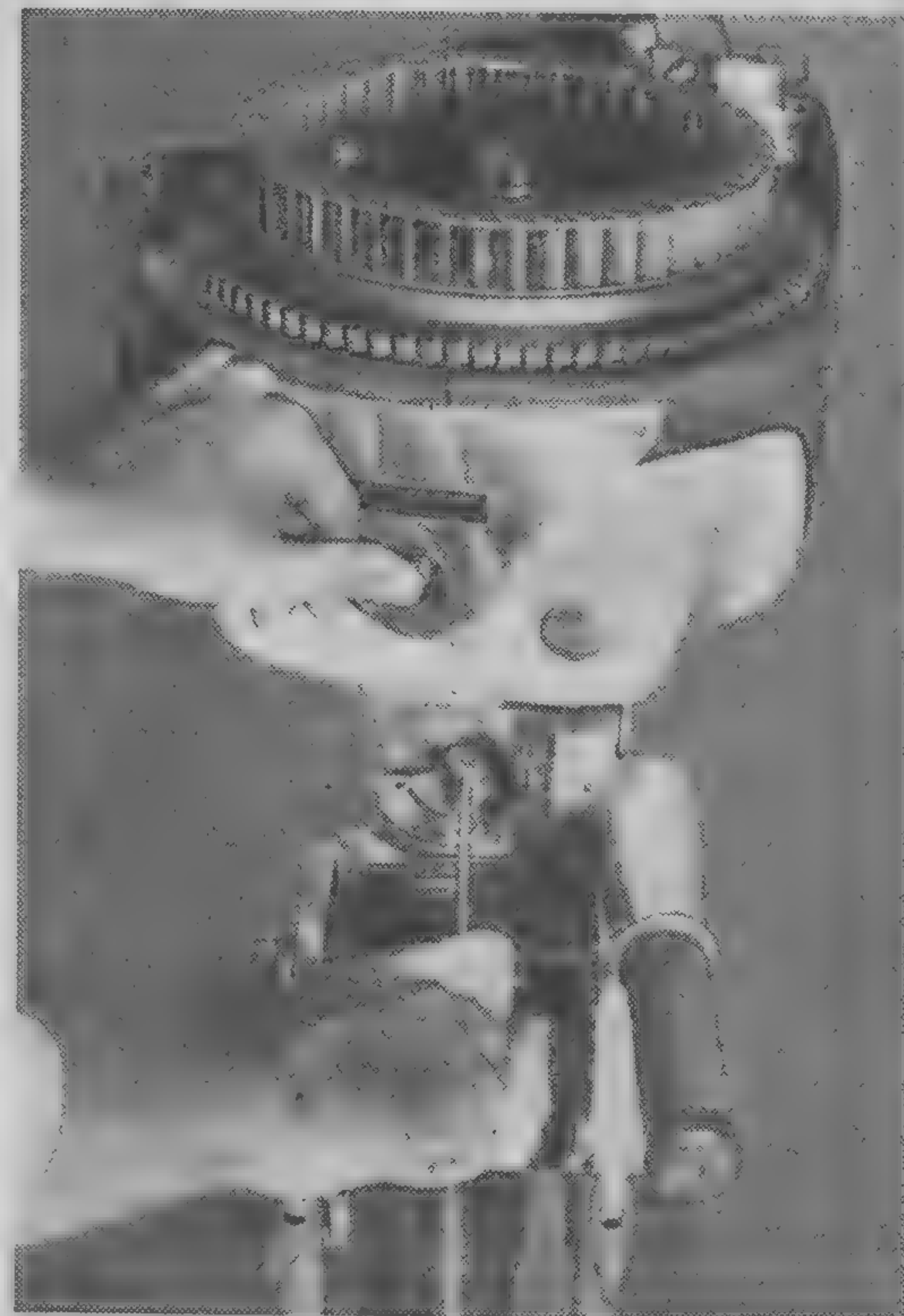
The engine? It's the just-unveiled American Marc-10, a 7½-hp diesel, destined—along with its sister 15 and 22-hp models—to churn up a coast-to-coast controversy as the nation's 5,525,000 outboard owners argue the virtues of gasoline versus diesel power.

The diesel's advantages lie in its low-cost operation, its safety (diesel fuel is much less of a fire hazard than gasoline) and its relative simplicity.

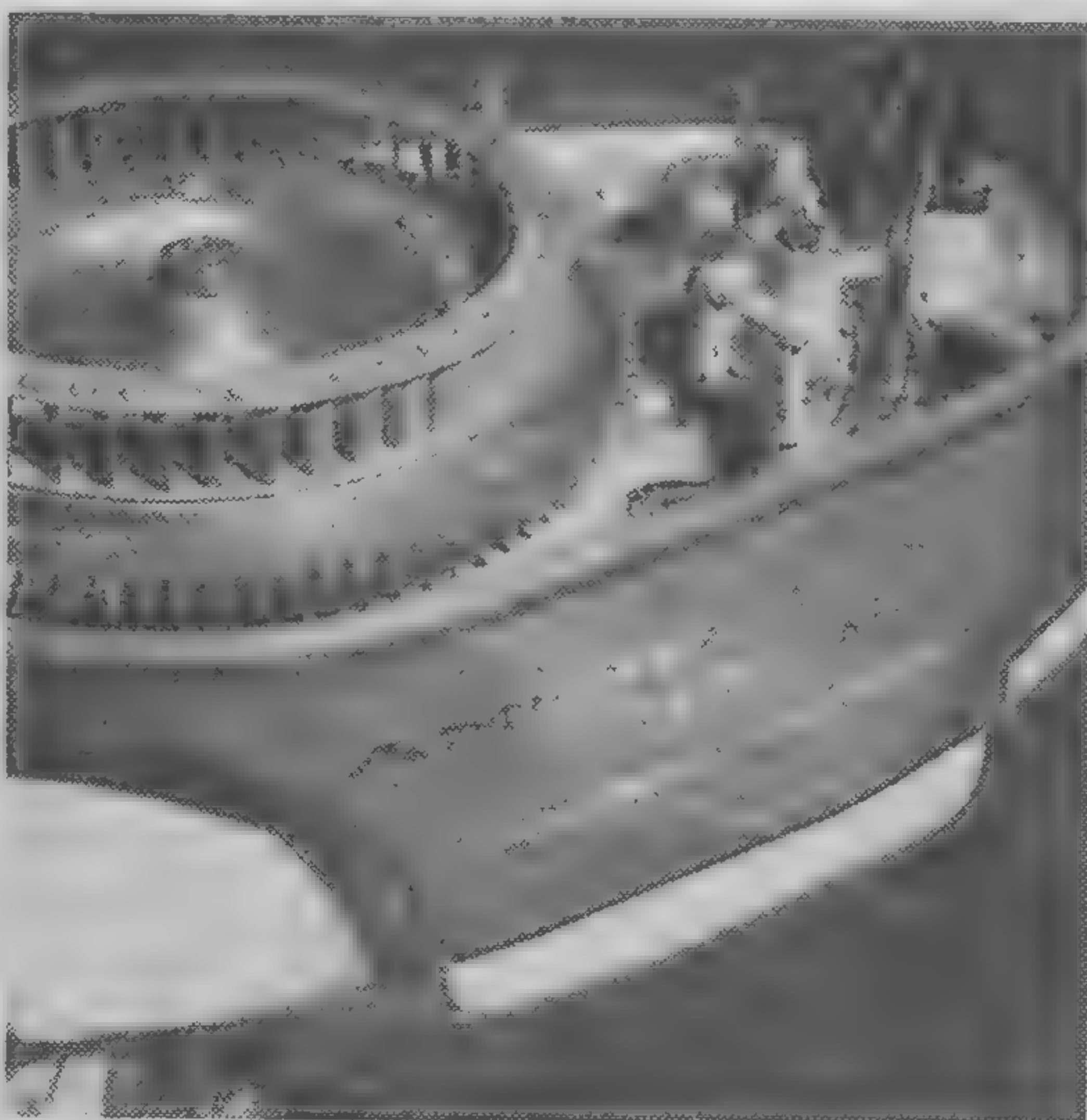
Its disadvantages are that for the rugged long life and low-cost operation he gets, the owner has to pay a premium—in weight and initial cost.

Originally designed under a Department of Defense contract for a diesel engine small enough to be backpacked by paratroopers, the Marc-10 pulls its power from two opposed pistons in a single cylinder.

At first glance, in fact, the engine seems to be all cylinder—the single cylinder (which is also the combustion chamber) cast around an iron sleeve. The manufacturer will make both air-



Closeup of air-cooled Marc-10 with fiber glass cowling removed shows gearshift, twist-grip throttle and push-button starter. Air-cooled model needs some 30 to 35 cubic feet of air per minute per horsepower. In normal operation, the cylinder's finned heat-transfer surfaces run about 350°F to 400°F.



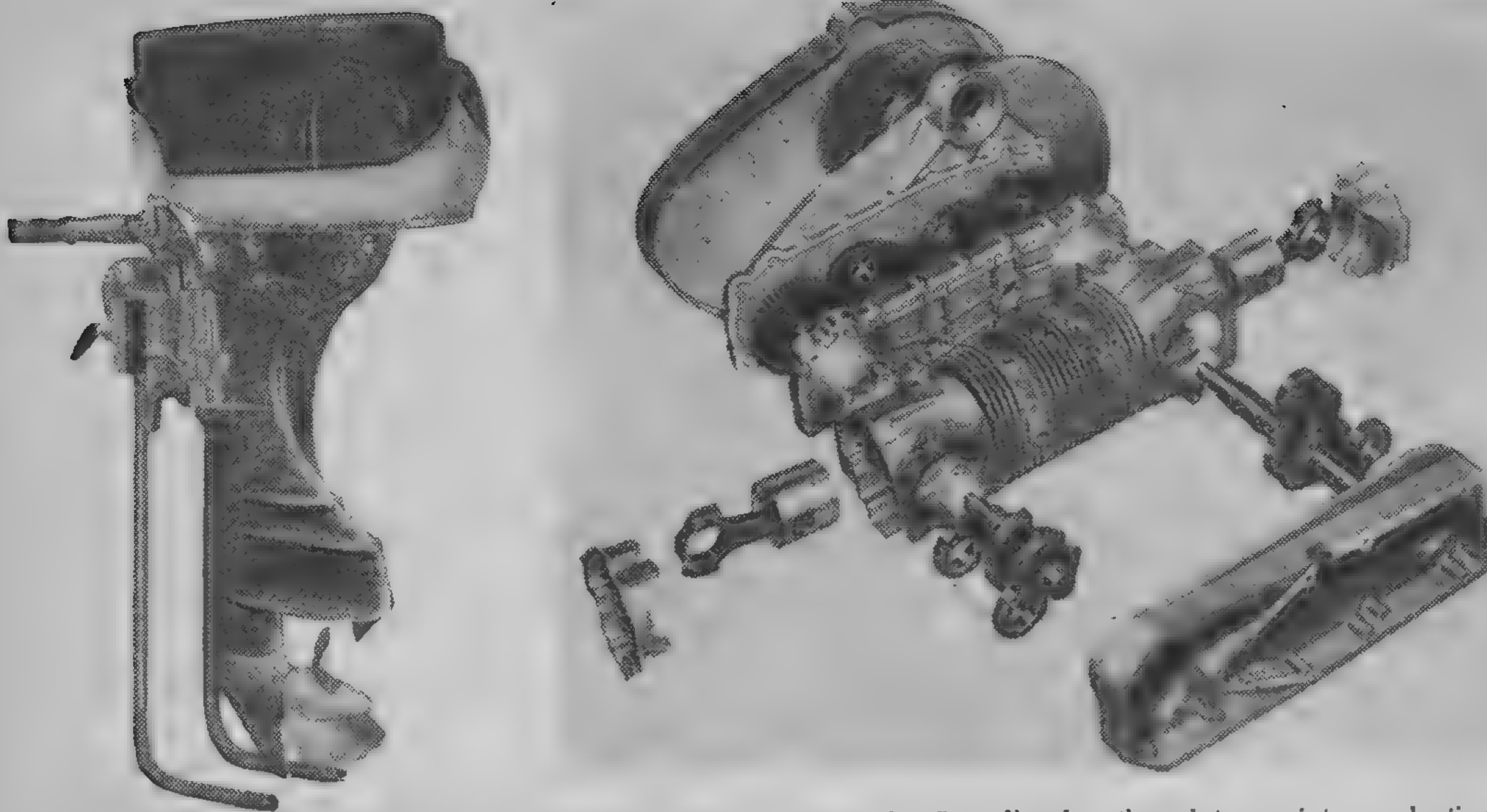
View of top of air-cooled Marc-10 shows, left to right, axial air-cooling fan, injector pump and lube pump. With top shroud in place, the only way you could tell it is a diesel is by the "Diesel Power" on lower part.

cooled and water-cooled motors.

The Marc-10 develops 7½ hp at 3500 rpm; its compression ratio is a hefty 23 to 1, compared to an average 6 to 1 for comparable gasoline motors. The motor has a 2½-inch bore with a 1⅞-inch stroke and an 18½-cubic inch displacement.

Its builder—American Marc, Inc., Inglewood, Calif.—says the motor can push a pleasure hull at better than 15 mph. And do it while gulping but two quarts of low-cost diesel fuel an hour (that's half the consumption of a comparable gasoline outboard, and diesel fuel costs anywhere from 10 to 20¢ less a gallon).

To visualize the opposed piston principle, imagine a metal tube with a plunger at each end. Push the plungers simultaneously toward the tube's center and they compress the air, raising its temperature to about 600°F. A shot of diesel fuel is then sprayed into the cylinder by a single injector. The fuel spontaneously burns in the hot



At left is the American Marc-10, a $7\frac{1}{2}$ hp diesel outboard motor—the first diesel outboard to go into production. Model shown is a prototype. Production models will be fancied up a bit, with a new shroud. At right, an exploded diagram of air-cooled motor. Note 4-gear train which transfers power from short crankshaft at left to the larger one at the right. Also note axial air-cooling fan under the air inlet vent at top of motor.

air and forces the pistons outward, thus turning two crankshafts, one attached to each piston. Through a 4-gear train, the crankshafts spin a 9-inch diameter, 2- or 3-blade prop.

In effect, the single cylinder acts as though it were two. More important, the two pistons balance one another, reducing noise and vibration (even so, the diesel outboards are apt to be noisier than their gasoline cousins).

Once the diesel starts, it all but runs itself. The reason: ignition is spontaneous, dependent solely on the compression of air within the cylinder.

Spontaneous ignition requires no carburetor, spark plugs or magnetos, but does require a high-pressure fuel pump and an injector. These two units are elaborate and finely-machined, therefore expensive.

Although no price tag has been fixed to the motor at the time of this writing, American Marc says it probably will cost about 50% more than comparable gas engines. Mentioned is a \$350 to \$450 price tag. By contrast, you can buy the same rated power in a gasoline outboard for around \$240 to \$270.

Weight per horsepower runs higher, too, for dieselization. Although the Marc-10's pistons and wrist pins are aluminum, they're built heavier and stronger than for gasoline-engine motors. Inherently, the diesel motor must be more rugged to withstand the tremendous pressures of compression and combustion.

The Marc-10 scales about 80 pounds. That's fully 20 pounds heavier than most first-line gas engines (one popular $7\frac{1}{2}$ -hp outboard tips the scales at 60 pounds, another at only 36).

Diesel designers seem confident, however, that boat owners will gladly pick up the higher tab—both price and weight-wise.

An American Marc spokesman says the company has a "potential backlog of 10,000 orders" from outboard dealers who are clamoring to scramble onto the diesel bandwagon. If the potentials become sales, they would represent about 2% of the U.S.'s annual outboard market.

American Marc says the motor will go at least 600 hours—about three years' normal use for the average weekend boatman—between major overhauls. In contrast, one of the Big Four gasoline motor manufacturers says its motor will go 500 hours between major overhauls and another claims 1000 hours.

Outwardly, the Marc-10 closely resembles gasoline motors of comparable horsepower. It is push-button started (a 12-volt dc battery, carried in the boat, energizes a starter motor which turns the crankshaft). A gearshift puts the prop into "neutral," "reverse," or "forward," and a twist-grip throttle regulates the injector pump, reducing or even shutting off fuel.

"Right here," says an American Marc engineer, "is one of the diesel's claims to efficiency. When you throttle it down, you don't interfere in any way with combustion air. So what fuel you use is squeezed of its maximum power. Throttle a gas engine, on the other hand, and you decrease both the fuel and air supply, so combustion at lower speeds is far less efficient."

This factor should make the Marc-10 an ideal trolling motor, for you anglers who like to ease through the lily pads for bass.

The diesel has its exhaust port underwater, incidentally, just above the prop. Underwater exhausting hushes the relatively slow-spinning engine (fully 500 rpm slower than for most gasoline outboards), and reduces the objectionable "clank" inherent in diesels.

2,000 Ton



A PORTABLE three- across water—will Lake Maracaibo in Ven

The island, with a 250 deck, will float to its fr giant feet to the lake b waves. When one sect island will lower the d

Besides lifting and p bridge, it will drill and port it. After completio fied for use as a mobile rich lake. The island v Longview, Tex.

"Test-Tube" Paving

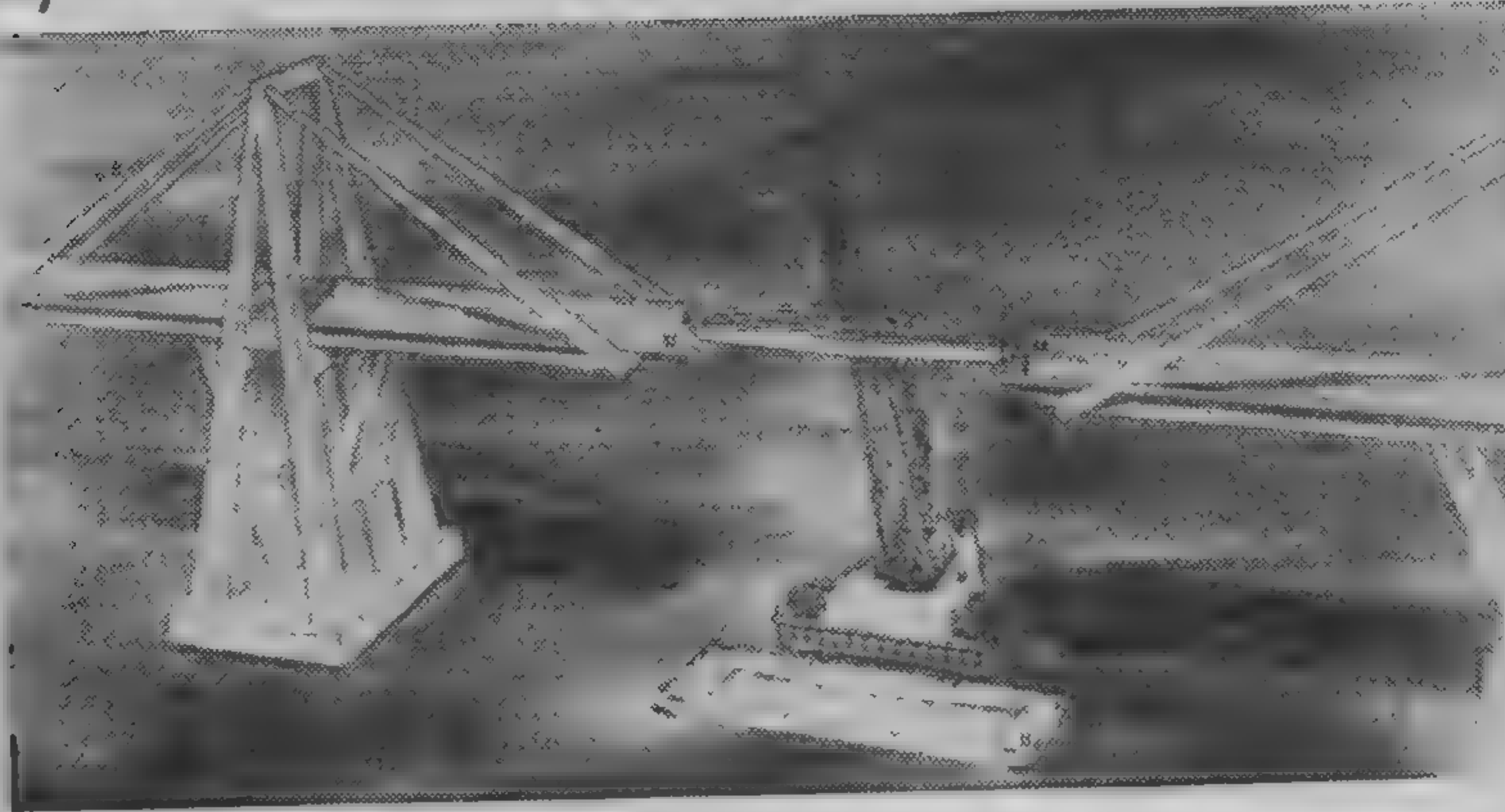
FOUR auto wheels sp highway—hour after tendant in charge—to t

The wheels are moun can be adjusted to ca bicycle up to the larges

Automated electronic tions on the roadway fr on into freezing, thaw ing, freezing and back to heat. What happens to pavement under these controlled conditions i observed and recorded electronically. Standard Oil Co., which operate the tester, says it wil save both time and money in highway research.

Each test slab of the mini ature highway is 1 foot wide, 3 feet long. Road way has a clay subgrade and specially built minia ture paving machines pr duce finished pavement from $1\frac{1}{2}$ to 3 inches thick

2,000 Ton Lake "Walker" to Build 6-Mile Bridge



Drawing shows how portable bridge builder will serve as the key tool in construction of 6-mile-long bridge. Crane lifts masonry section into place, while the barge in front of the unit holds another.

Thirty stories tall, the bridge builder dwarfs men on its deck and the big 20-yard earthmover on the ground. Its mammoth crane is powered by seven ac and dc electric motors, which get their power from dynamos driven by a battery of Cummins diesel engines totalling 1200 hp.

A PORTABLE three-legged "island"—capable of "walking" across water—will help build a 6-mile-long bridge across Lake Maracaibo in Venezuela.

The island, with a 250-ton marine crane towering above its deck, will float to its first work position, then lower its three giant feet to the lake bottom, lifting the deck well above the waves. When one section of the bridge is completed, the island will lower the deck, raise its legs and move forward.

Besides lifting and placing sections for the all-masonry bridge, it will drill and set the concrete piles which will support it. After completion of the bridge, the unit can be modified for use as a mobile offshore drilling platform on the oil-rich lake. The island was built by R. G. LeTourneau, Inc., Longview, Tex.

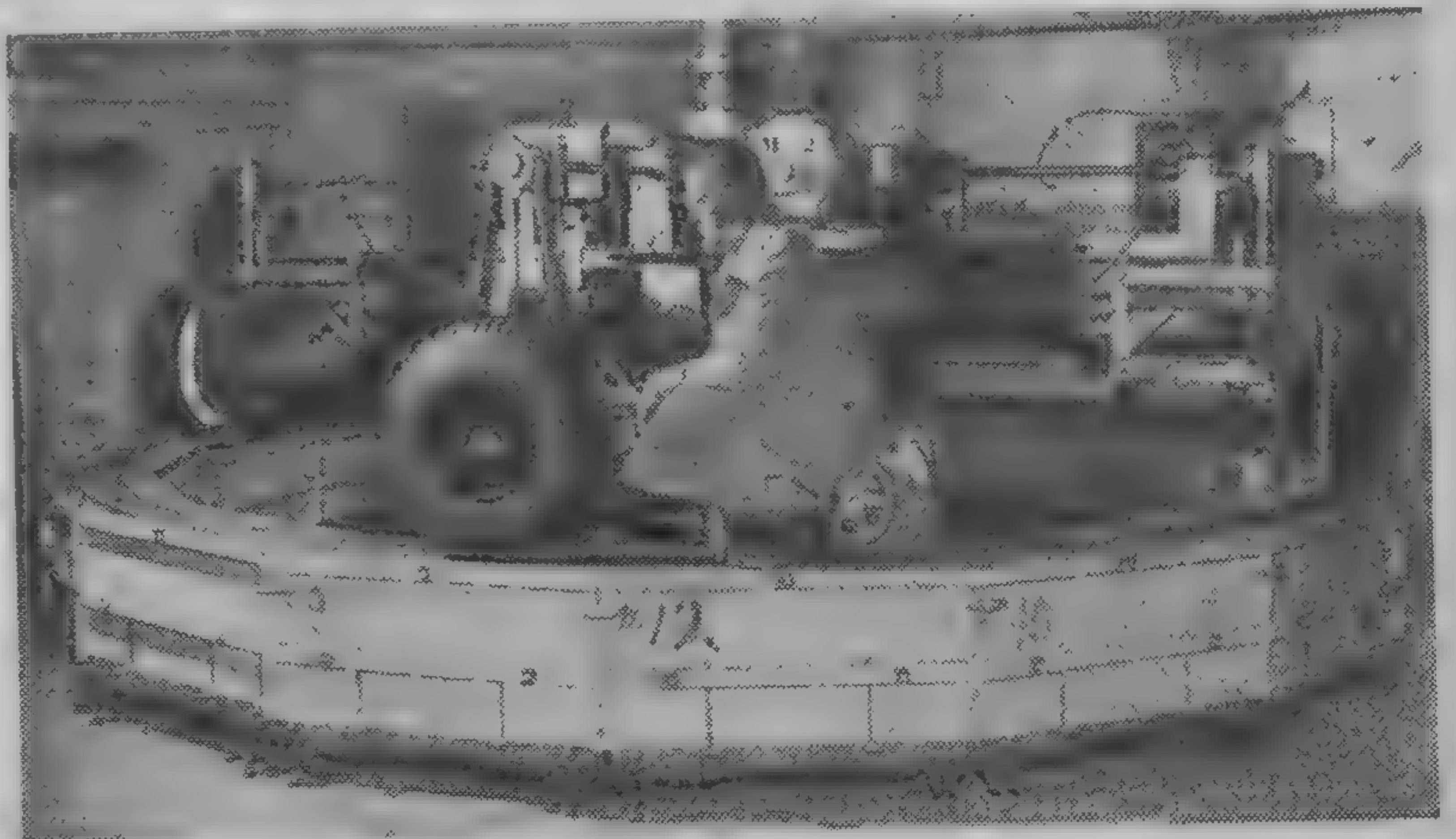
"Test-Tube" Highway Speeds Paving Research

FOUR auto wheels speed around this circular "test-tube" highway—hour after hour, with only an electronic attendant in charge—to test new paving materials.

The wheels are mounted on a variable speed spindle and can be adjusted to carry the weight of anything from a bicycle up to the largest over-the-highway truck transport.

Automated electronic equipment changes weather conditions on the roadway from desert-dry heat into a cloudburst, on into freezing, thawing, freezing and back to heat. What happens to pavement under these controlled conditions is observed and recorded electronically. Standard Oil Co., which operates the tester, says it will save both time and money in highway research.

Each test slab of the miniature highway is 1 foot wide, 3 feet long. Roadway has a clay subgrade, and specially built miniature paving machines produce finished pavements from 1½ to 3 inches thick.



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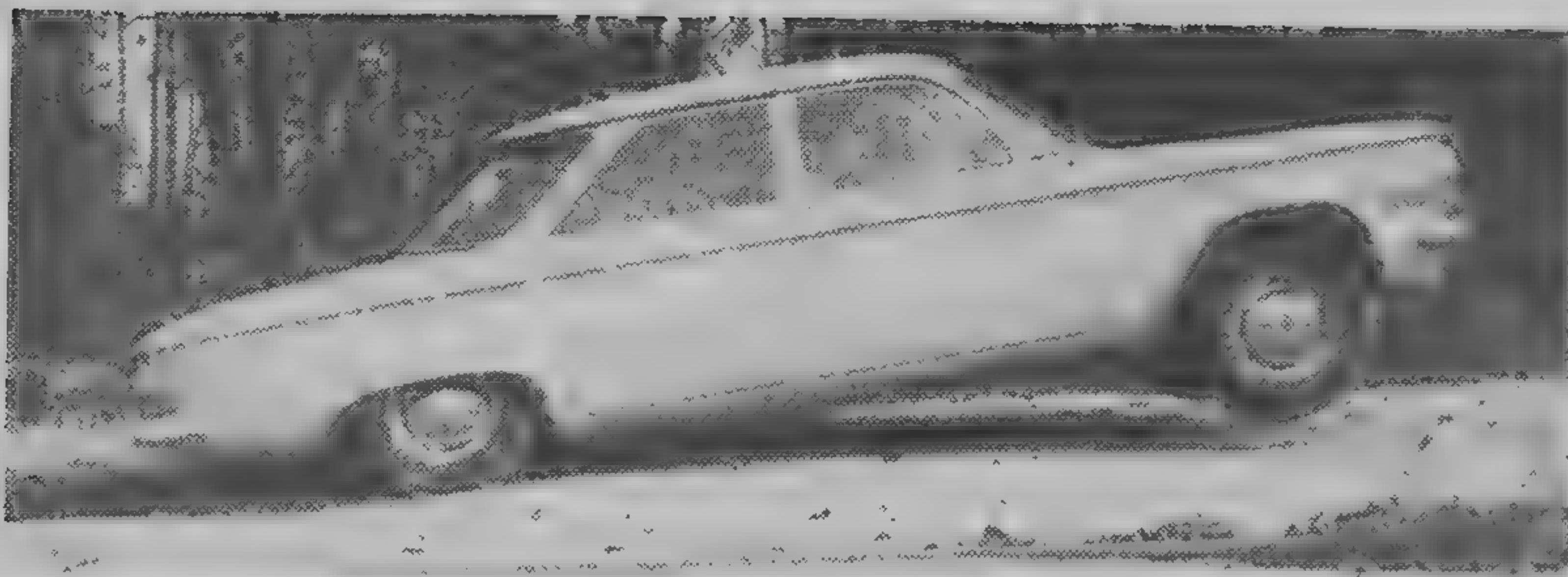
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Coming up out of an abrupt road dip at 30 mph—the only time the handling of the remarkably stable Corvair felt the least bit uneasy. The Corvair's cornering, maneuverability, traction on slick surfaces, and road holding (even in strong crosswinds), were all excellent.

Comparison Testing the Corvair and Falcon

How test results—rather than opinions—reveal the true picture on economy and performance

By DON DINWIDDIE

WIDE-EYED auto editors have all had their say about the new compact cars. Now it's time to let some independent test results do the talking.

After driving each test car over 1,000 miles, the message we got was an emphatic one. The Falcon very definitely delivered the best fuel mileage, and the Corvair showed the greatest handling dexterity. (In the next issue, we'll tell you where the Valiant—now being tested—fits into the picture).

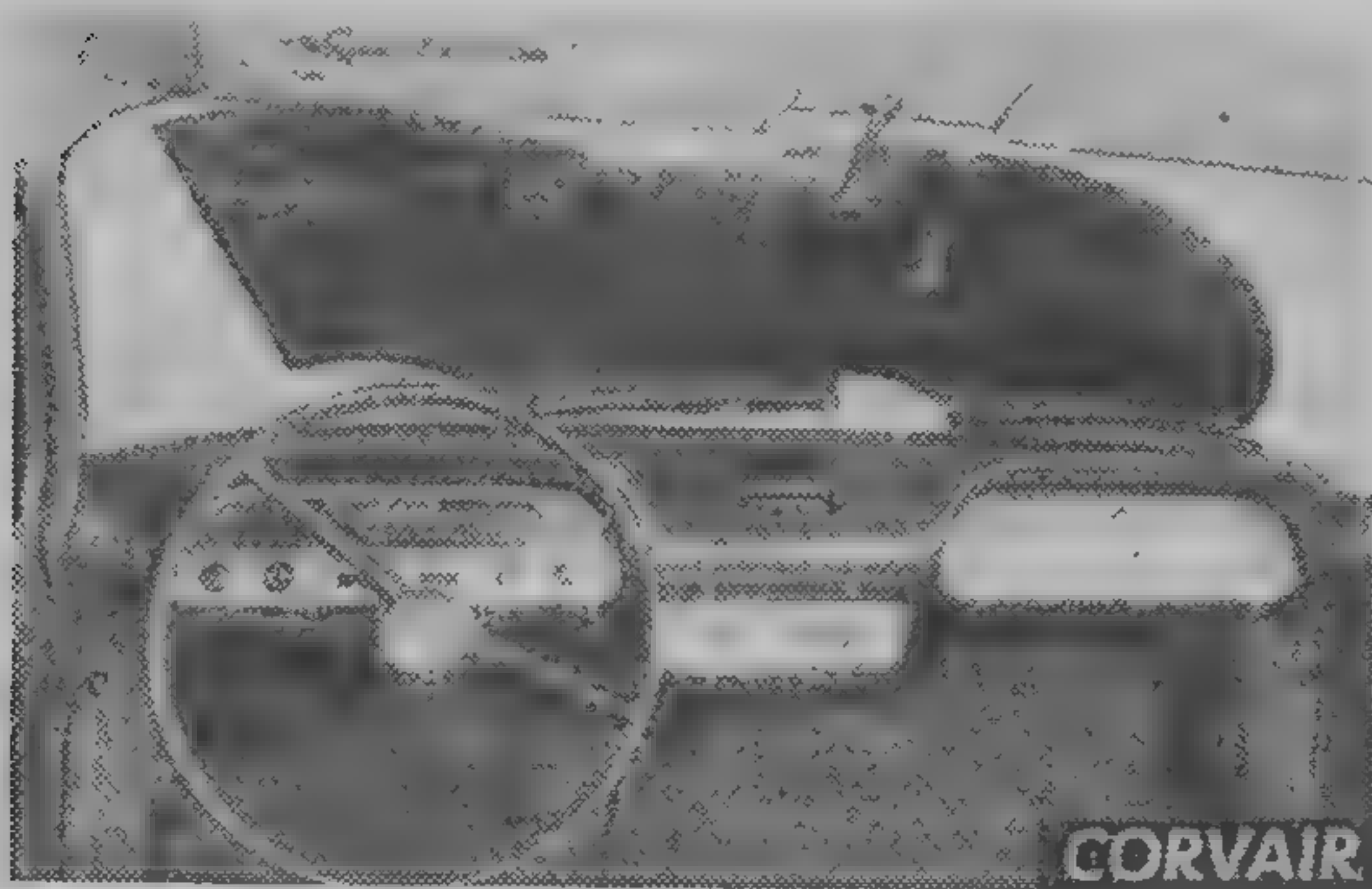
But hold on there, hollers a would-be Corvair owner. Remember you were testing a Corvair equipped with gas-wasting automatic transmission against a Falcon with gas-saving stick shift. True, my friend, very true. That is the only way each of these cars was being delivered in Chicago at the time our tests were run, and neither Uncle Art's influence nor Aunt Hepzibah's stocks and bonds could have secured for us a perfect match in test car transmissions.



The side tilt of the Falcon on sharp cornering was $3\frac{1}{2}^\circ$ —the same angle that was recorded by last year's Ford. On the same circle test, the Corvair's side tilt was $2\frac{1}{2}^\circ$.

If a Corvair with stick shift had been available, it would probably have turned out more miles per gallon than our test chart shows, even though its relatively high rear axle ratio (3.55 vs. 3.10:1 for Falcon) isn't as economy-minded. The Corvair would almost certainly have failed to catch up with our test Falcon on traffic and overall fuel economy. Nor was our test Corvair a proverbial lemon. To reassure ourselves on this point, we ran a set of fuel mileage tests on a second Corvair. It proved less economical than the first one.

At steady speeds of around 70 mph, the picture changes somewhat, with the Corvair for the first time showing a slight edge on economy. Here the thirst of the Corvair's two carbs (versus the Falcon's one) is not as damaging. Also, the 13% smaller frontal area of the Corvair means that



Dash panel layouts on both cars are well designed for easy reading and reaching. Note wiper clearance arcs.

proportionately less than the increasing wind reason, the slightly heavier car is almost able to match the lighter, more powerful Falcon.

On the acceleration test, the Corvair owner's argument. Here again the shift does a more efficient job than the 2-speed automatic. The Falcon winning from standstill, and the Corvair spurts from 20 and 40 mph.

A Corvair equipped with a 2-speed automatic. The Falcon equipped with a 2-speed automatic. The Corvair equipped with a 2-speed automatic. The Falcon equipped with a 2-speed automatic.

Driver's Observations

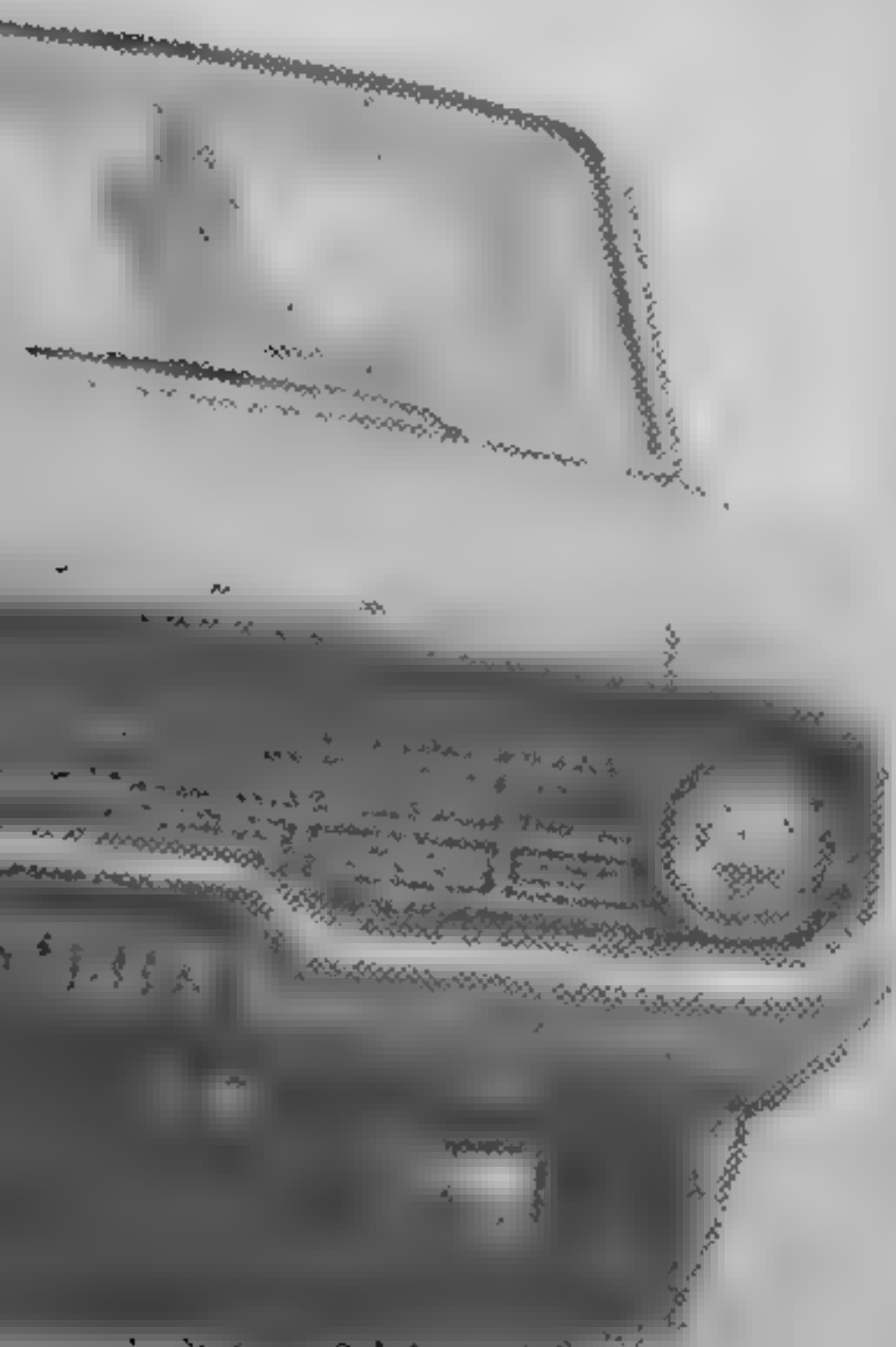
Roadability: Corvair's ride is smooth at any speed. Falcon slightly more on turns but cornering is excellent. Neither car showed appreciable body roll, even in 40 mph gusts. Cars "feel" the wind, but it doesn't cause steering or drift the car. Traction on the Corvair is excellent.

Riding and Driving Comfort: Seats are more comfortable in the Corvair driver's seat. The Falcon's center squashes, making it uncomfortable. Right side of driver's seat is easily on test Corvair. Support in both. You're not on the edge of Corvair seat when it's so low. Leg clearance is excellent. Lack of driveshaft vibration makes center position roomy. Corvair is noisy at low speeds, but quiet except for slight drift at mid-speeds. Corvair's soft, Falcon has the greatest steering is slower and requires more effort.

Instruments and Controls: Both cars have instruments in both cars and instruments to read. Falcon has no idiot lights for ampere and one for temperature. Corvair's easy wiper shift lever protrudes from the dashboard up-down motion for order from the bottom. Conventional, and worked well. Linkage adjustment was correct. Falcon front window has rear window, $1\frac{1}{2}$ turns down. Corvair has $3\frac{1}{4}$ stiff 4 turns in back. Engine on each car opens from the jack works well without the Corvair jack must be placed on body to avoid crinkles, aerate because handle is on ground.

Miscellaneous: Either car is a joy to service, because of parts accessibility. Finish and trim was general. Cars, we noted a few problems. Less haste, more

Coming up out of an abrupt road dip at 30 mph—the only time the handling of the remarkably stable Corvair felt the least bit uneasy. The Corvair's cornering, maneuverability, traction on slick surfaces, and road holding (even in strong crosswinds), were all excellent.



on sharp cornering was recorded by last circle test, the Corvair's was 2½°.

shift had been available, turned out more miles than shows, even though the ratio (3.55 vs. 3.10:1) is more mind-boggling. The Corvair has failed to catch up in traffic and overall fuel economy. The Corvair is a proverbial fish out of water on this point, we tested on a second Corvair. The first one. At 70 mph, the picture of the Corvair for the first time on economy. Here the Corvair (versus the Falcon) is lagging. Also, the 13% difference Corvair means that



wiper clearance arcs.

proportionately less horsepower is needed to fight the increasing wind resistance. For the same reason, the slightly heavier 80-hp Corvair was almost able to match the 82.6 mph top speed of the lighter, more powerful 90-hp Falcon.

On the acceleration tests, our friend the prospective Corvair owner might have a more valid argument. Here again, the Falcon's 3-speed stick shift does a more efficient job than the Corvair's 2-speed automatic. And the race is close—with the Falcon winning the acceleration tests run from standstill, and the Corvair taking the traffic spurts from 20 and 40 mph.

A Corvair equipped with stick shift versus a Falcon equipped with automatic would undoubtedly change the picture—in fact, it did when we

clocked just such a competitive combination late last year near Detroit and Dearborn. Then the stick shift Corvair out-accelerated the automatic transmission Falcon across the board.

On a matched transmission basis, however, the race will continue close enough to provoke arguments for some time to come. The Corvair—weighing more and delivering less power to the rear wheels—offsets these hindrances by using a higher rear axle ratio (3.55 versus the Falcon's 3.10:1 with stick shift).

Just wait until the boys get through doctoring up both cars with special speed equipment, though, if you want to see some real contests.

The Big Three were obviously not trying for speedier cars when they brought out the new

Driver's Observations

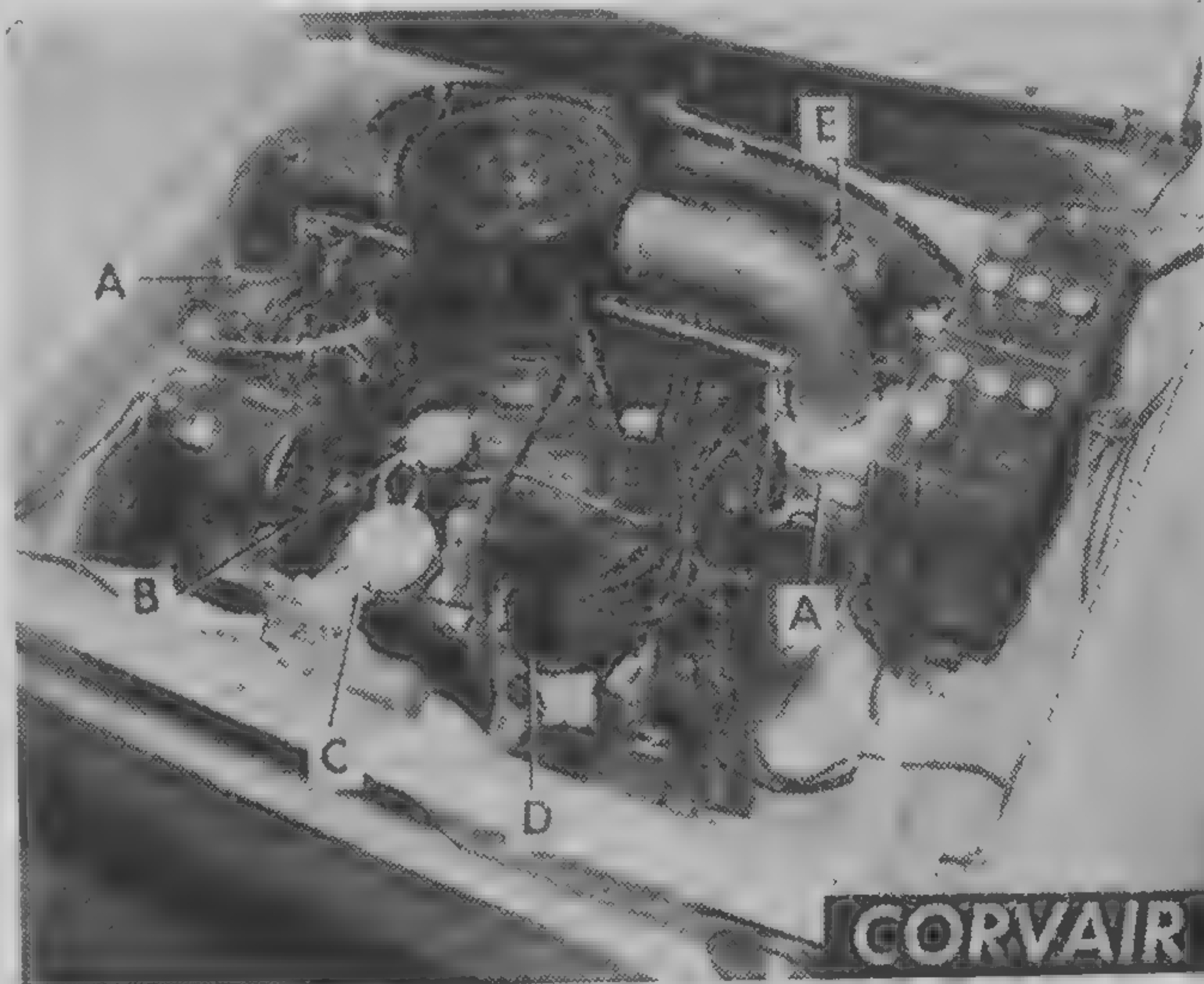
Roadability: Corvair snug and stable at any speed. Falcon slightly jouncier and leans more on turns but corners and tracks well. Neither car showed appreciable wind wander, even in 40 mph gusts. These smaller cars "feel" the wind, but it does not pull the steering or drift the car across the road. Traction on the Corvair is exceptional.

Riding and Driving Comfort: Falcon seats are more comfortable, won't bottom. Corvair driver's seat harder on door side, center squashes, making driver ride at an angle. Right side of driver's seat bottomed easily on test Corvair. Fairly good thigh support in both. You're tempted to step on edge of Corvair seat when entering because it's so low. Leg clearances generous on both cars. Lack of driveshaft hump in Corvair makes center position roomy. Corvair slightly noisy at low speeds, Falcon generally quiet except for slight driveshaft vibration at mid-speeds. Corvair brakes and steering soft, Falcon has the greater oversteer and steering is slower and requires more effort.

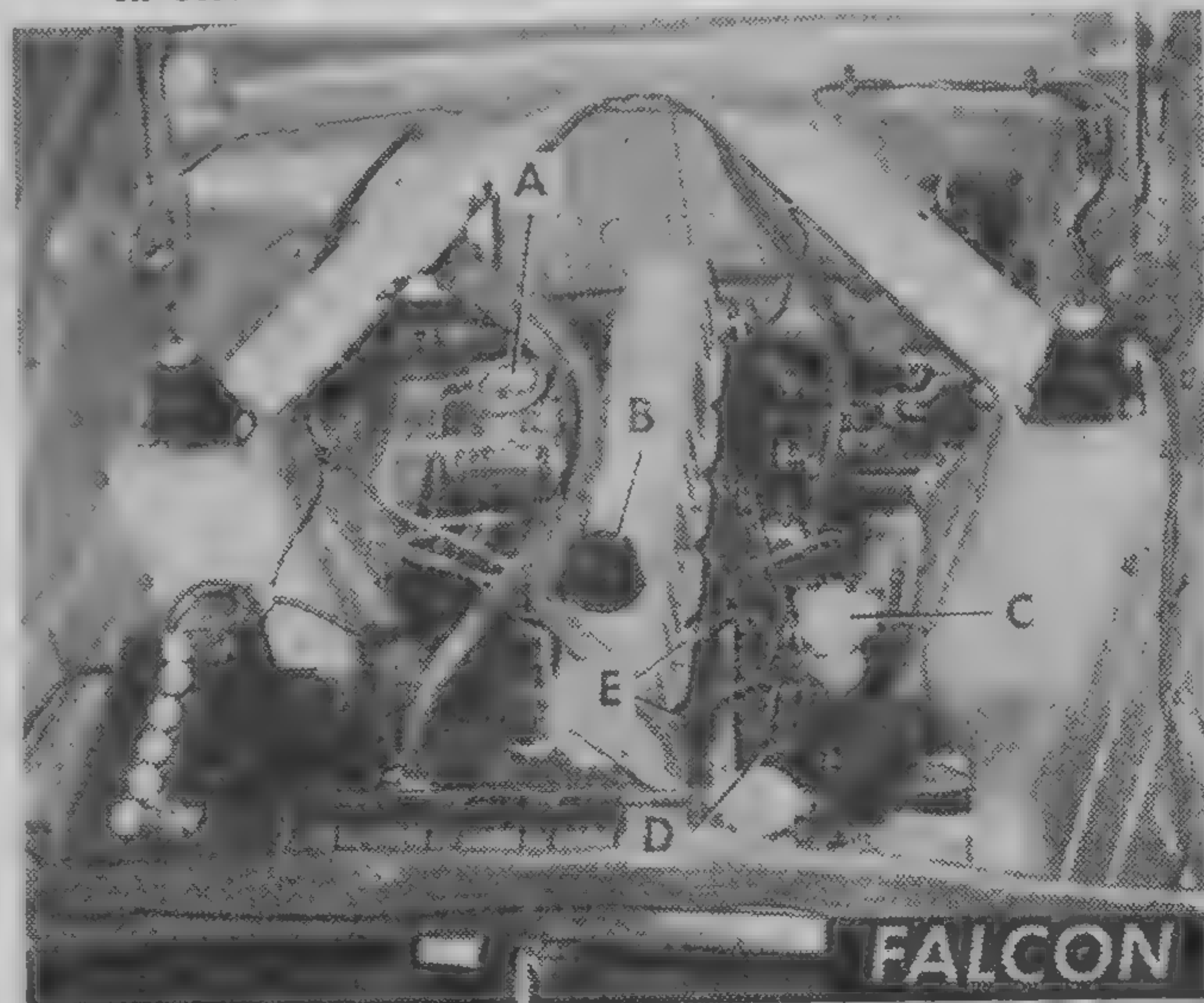
Instruments and Controls: Good vision in both cars and instruments are easy to read. Falcon has normal complement plus idiot lights for amps and oil. Corvair has one idiot light for temperature-oil pressure and one for generator and fan combined. Corvair's easy working automatic shift lever protrudes from dash, works with sure up-down motion for RNDL in that order from the bottom. Ford shift is conventional, and worked well after a stubborn linkage adjustment was corrected.

Falcon front window has 3 turns; on the rear window, 1½ turns take it halfway down. Corvair has 3¼ turns in front, a stiff 4 turns in back. Engine compartment on each car opens from outside. Falcon jack works well without deforming bumpers. Corvair jack must be placed just right under body to avoid crinkles, and is hard to operate because handle is almost on the ground.

Miscellaneous: Either engine should be a joy to service, because of its simplicity and parts accessibility. While quality of finish and trim was generally good on both cars, we noted a few poor trim fits. The solution? Less haste, more pride.



Corvair's air-cooled rear engine (above) and Falcon's water-cooled front engine (below). Note accessibility of service points: (A) carburetors; (B) oil fill; (C) fuel pump; (D) distributor; (E) dipstick. Spark plugs (F) are easily reached on Falcon, and also accessible on Corvair after metal covering plate has been removed.



compact models. In fact, last year's Ford and Chevrolet traveled from 40 to 60 mph in about half the time it took this year's Falcon and Corvair. Of course, they drank up a lot more gasoline doing it. In our city-country fuel mileage tests, for example, the Corvair went 114.1 miles on five gallons of gas, while our 1959 test Chevrolet could only squeeze 76.1 miles out of its allotted five gallons. And the Falcon went 166.2

TECH TALK

Although its sales record speaks for itself, Volkswagen is famous for having frostbitten drivers. An air-cooled rear engine simply doesn't deliver enough heat to make the passenger compartment comfortable in chill climates. So the sales of supplementary heaters for VWs is moderately brisk.

Corvair solves the problem by installing a large gasoline heater in the front trunk. It's optional, but those north of the Mason-Dixon line will certainly consider it essential.

How Much Gasoline Will It Use?

A good question, inasmuch as you must add the gasoline consumed by a separate heater to the gasoline used to run the car, if you want to determine how economical the car is to operate. The Corvair's heater is fed by the engine fuel pump and fuel not used is by-passed back to the tank. By disconnecting the by-pass and letting the fuel regulator function normally, we were able to measure the maximum full running time rate of heater gasoline consumption. It is 0.27 gallons per hour.

That isn't normal consumption, however, because the thermostatic control in the heater will keep it shut off most of the time. Further testing showed that, after reaching equilibrium temperature, the heater would maintain 70°F in the car with the outside temperature at 50°F, while using 0.015 gallons of gasoline per hour and running 6% of the time. With an outside temperature of minus 10°F, the heater will use about 0.060 gph to maintain 70°F inside temperature.

In terms of relative fuel consumption, you can figure that, in below zero weather, about 5% of the fuel you buy will be used by the heater.

Carbon Monoxide and Explosions.

The fuel-air ratio in the Corvair heater is low enough to keep carbon monoxide from being present at the outlet under the car floor. Add the fact that CO is less likely to work its way forward from the rear engine into the passenger compartment and you probably have less CO danger than you would have with a front-engine car.

One word of warning, though. Don't carry spare gasoline for lawnmowers or outboard motors in the luggage compartment. We know of one case where a tightly-sealed can had enough gasoline lying on the rim to cause an explosion triggered by the induction coil of the Corvair's heater.

Science at the Wheel

MODELS TESTED: 1960 Corvair 700, 4-Door Sedan
1960 Falcon Deluxe, 2-Door Sedan

GENERAL ROAD AND WEATHER CONDITIONS: Cars were tested between October 8, 1959 and November 2, 1959. All road tests were on dry Portland concrete, except for overall gas mileage, which included driving on various types of surfaces, both wet and dry.

	CORVAIR	FALCON
MILEAGE at PICKUP *	60	291.7
MILES COVERED	1069	1137.2
CURB WEIGHTS	2470	2375
WEIGHT DISTRIBUTION	38.5-61.5%	53.7-46.3%
TIRE PRESSURE (FR & RR)	15-26	24-24
SPARK SETTINGS (°BTC)	4° @ 700 rpm	2° @ 500 rpm
REAR AXLE RATIOS	3.55:1	3.10:1
TRANSMISSIONS	Automatic	Stick
RATIOS: LOW	1.82:1	3.29:1
2ND OR DRIVE	1.00:1	1.75:1
3RD	1.82:1	1.00:1
REVERSE		4.46:1
CONVERTER RATIO AT STALL SPEED	2.6 @ 1600	(No Converter)

* No instrumented fuel or acceleration tests were run until car mileage exceeded 500 miles.

TEST DATA

GASOLINE MILEAGE: Checked with fuel flow volume meter and 5th wheel. Temperature prevailing was 57° F. for both cars. Relative humidities were 82% for Corvair, 56% for Falcon. Barometer readings were 29.6 for both cars.

LEVEL ROAD FUEL CONSUMPTION: Average of two or more runs made in opposite directions over same road. Carried weights were: Corvair 430; Falcon 415 lbs.

TRUE MPG at a true	20 mph	30 mph	40 mph	50 mph	60 mph	70 mph
CORVAIR	27.5	28.8	27.3	25.5	23.7	22.0
FALCON	37.3	38.0	34.3	30.1	25.9	21.8
TRUE TON MPG at	20 mph	30 mph	40 mph	50 mph	60 mph	70 mph
CORVAIR	39.8	41.8	39.6	37.0	34.4	31.9
FALCON	51.9	52.8	47.7	41.8	36.0	30.3

TRAFFIC FUEL CONSUMPTION: Simulated traffic pattern of city driving—stops, acceleration, braking at speeds of primarily 30-45 mph. Carried weights were: Corvair 420; Falcon 400 lbs.

	True MPG	True Ton MPG	True Average MPH
CORVAIR	16.4	23.8	22.9
FALCON	19.0	26.4	23.1

CITY-COUNTRY FUEL CONSUMPTION: Miles covered with 5 gallons of gas on course combining open country roads and slower city traffic driving, at speeds of 30, 40, 50, and 60 mph.

	True MPG	True Mileage	True Aver. MPH
CORVAIR	22.9	114.4	33.2
FALCON	28.1	166.2	33.2

OVERALL FUEL AND OIL CONSUMED DURING ALL TESTS, including idling, warmups, driving to and from test areas, acceleration runs and dynamometer testing.

	True MPG	Total Mileage	Total Gal. Gas	Total Qt. Oil	OIL MPQ
CORVAIR	17.5	1081.0	61.7	2	541
FALCON	22.7	1137.2	50.0	None	—

OVERALL EFFICIENCY in moving car's mass against road friction and air resistance calculated from level road mpg, weight and frontal area of car.

	at 30 MPH	at 60 MPH
CORVAIR	10.7%	17.6%
FALCON	14.7%	19.5%

ACCELERATION ON LEVEL ROAD, timed with 5th wheel. Carried weights were: 400 lbs. for Corvair; 470 for Falcon. Test weather conditions were: 53-61°F temperatures; 62-67% relative humidity; 29.5-29.7 barometer readings.

Elapsed Time in Seconds					
	0-20 mph	0-30 mph	0-40 mph	0-50 mph	0-60 mph
CORVAIR	4.20	7.20	10.2	15.1	22.1
FALCON	3.60	6.00	9.60	13.8	21.0
	20-40 mph		40-60 mph		
CORVAIR	7.14		12.6		
FALCON	7.20		14.0		

GEARSHIFT PATTERNS W speed in high; for Falcon in 3rd.

MINIMUM 0-60 MPH TRUE wind, best spark setting 17.7.

QUARTER-MILE SPEED and

CORVAIR
FALCON

TOP SPEEDS: (MPH true) vair 82; Falcon 82.6.

ACCELERATION FACTORS

TRUE MPH	Gear	MPH/Sec
10	Lo	4.9
20	Lo	4.1
30	Lo	3.3
40	Lo	2.6
50	Dr	1.9
60	Dr	1.3

ODOMETER CORRECTION Corvair registered 10.06 distance of 10 miles, F error).

SPEEDOMETER CORRECTION

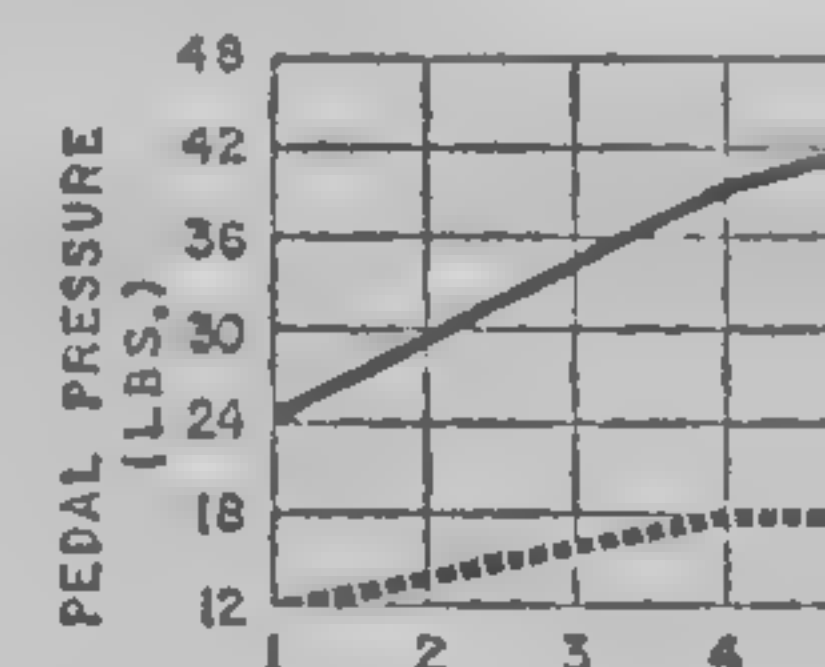
True Speeds were	20 mph
CORVAIR	21.3
FALCON	20.3

HILL CLIMBING and DRA

	Approx.
CORVAIR	30
	60
FALCON	30
	60

CORNERING SWAY TEST: circle, side tilt angles r for Falcon.

BRAKE FADE TESTS: Repe to 30 mph at deceleration effort patterns:



NOSE DIP ON BRAKING: A body diving angle was l

PARKING BRAKE TESTS. 20 mph true speed car s Parking brake stopping ratchet design required lease on handle.

CHASSIS DYNAMOMETER tomotive Service, Chica midities 55-63%; Barome

Engine RPM	2400
Horsepower	30.0

HORSEPOWER at REAR A data with allowances n eria:

	CORVAIR
Engine	Equiv.
RPM	Torque
3600	lb. ft.
3100	72.7
2600	81.3
	86.8

Advertised engine HP reac

HP
%

4-Door Sedan
e, 2-Door Sedan

CONDITIONS: Cars were tested
ember 2, 1959. All road tests
except for overall gas mileage
types of surfaces, both wet

CORVAIR	FALCON
60	291.7
1069	1137.2
2470	2375
35.5-61.5%	53.7-46.3%
15-26	24-24
@ 700 rpm	2° @ 500 rpm
3.55:1	3.10:1
Automatic	Stick
1.82:1	3.29:1
1.00:1	1.75:1
	1.00:1
1.82:1	4.46:1

@ 1600 (No Converter)
n tests were run until car mile-

TA

el flow volume meter and 5th
57° F. for both cars. Relative
% for Falcon. Barometer read-

Average of two or more runs
same road. Carried weights

mph	50 mph	60 mph	70 mph
25.5	23.7	22.0	
30.1	25.9	21.8	

mph	50 mph	60 mph	70 mph
37.0	34.4	31.9	
41.8	36.0	30.3	

ulated traffic pattern of city
at speeds of primarily 30-45
420; Falcon 400 lbs.

True Ton MPG	True Average MPH
23.8	22.9
26.4	23.1

Miles covered with 5 gallons
untry roads and slower city
, and 60 mph.

True Mileage	True Aver. MPH
114.4	33.2
166.2	33.2

DURING ALL TESTS, includ-
from test areas, acceleration

Gal. Gas	Total Qt. Oil	OIL MPQ
61.7	2	541
50.0	None	—

mass against road friction
level road mpg, weight and

at 60 MPH
17.6%
19.5%

ed with 5th wheel. Carried
0 for Falcon.

temperatures; 62-67% rela-
dings.

Seconds	0-50 mph	0-60 mph
10.2	15.1	22.1
9.60	13.8	21.0

40-60 mph
12.6
14.0

GEARSHIFT PATTERNS WERE: for Corvair, 0-48 mph in 1st, 48-to-speed in high; for Falcon, 0-31 mph in 1st, 31-60 in 2nd, 60-to-speed in 3rd.

MINIMUM 0-60 MPH TRUE TIME in seconds over level road with no wind, best spark setting, and driver alone: Corvair 19.3; Falcon 17.7.

QUARTER-MILE SPEED and TIME from STANDSTILL:

	MPH	Seconds
CORVAIR	61.1	23.0
FALCON	61.0	21.8

TOP SPEEDS: (MPH true reached within one mile from start): Corvair 82; Falcon 82.6.

ACCELERATION FACTORS:

CORVAIR				FALCON			
TRUE MPH	Gear	MPH/Sec	Ft/Sec ²	Gear	MPH/Sec	Ft/Sec ²	
10	Lo	4.9	7.2	1st	5.7	8.3	
20	Lo	4.1	6.0	1st	4.6	6.8	
30	Lo	3.3	4.8	1st	3.5	5.1	
40	Lo	2.6	3.8	2nd	2.8	4.1	
50	Dr	1.9	2.8	2nd	2.1	3.1	
60	Dr	1.3	1.9	3rd	1.4	2.05	

ODOMETER CORRECTIONS: For an odometer distance of 10 miles Corvair registered 10.06 true miles (.597% error). For an odometer distance of 10 miles, Falcon registered 9.88 true miles (1.21% error).

SPEEDOMETER CORRECTIONS: At speedometer readings of

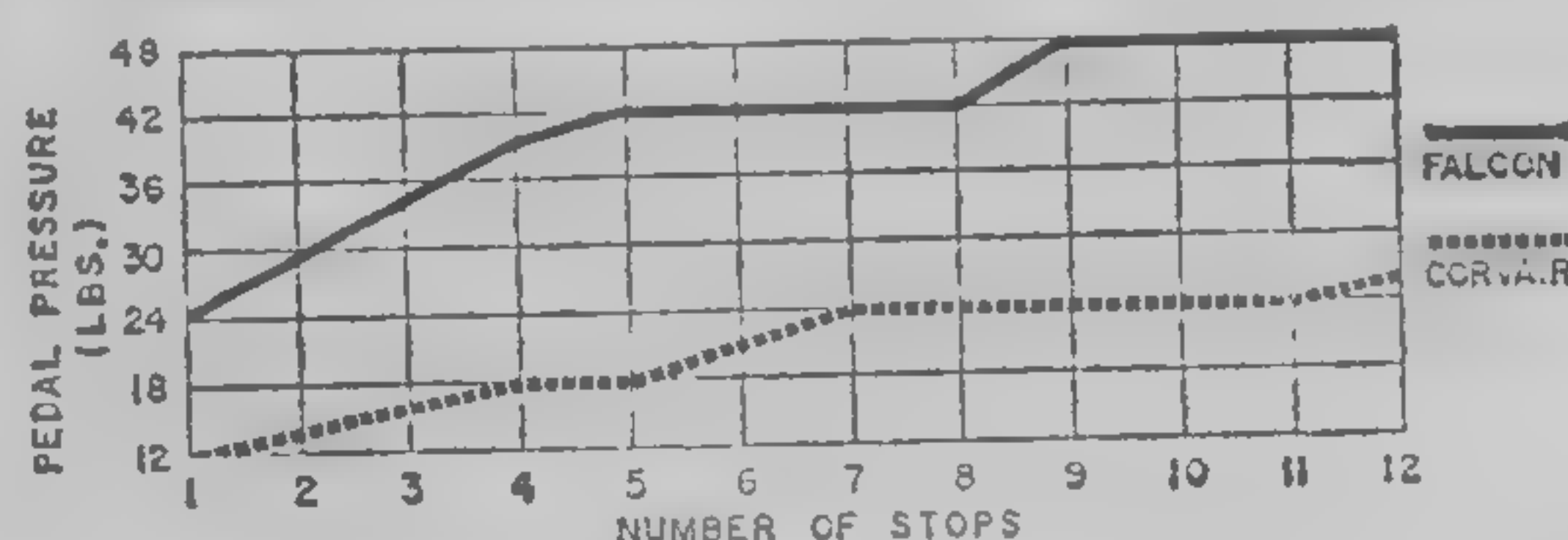
True Speeds were	20 mph	30 mph	40 mph	50 mph	60 mph	70 mph
CORVAIR	21.3	31.2	40.6	50.2	60.2	70.1
FALCON	20.3	29.8	39.4	49.6	59.6	69.6

HILL CLIMBING and DRAWBAR PULL:

	Approx. MPH	Gear	Grade%	Pull in lb
CORVAIR	30	LO	15.2	431
	60	DR	6.0	172
FALCON	30	2nd	16.2	455
	60	3rd	6.1	174

CORNERING SWAY TEST: At a steady 40 mph on 285 ft. radius test circle, side tilt angles recorded were: 2½° for Corvair and 3½° for Falcon.

BRAKE FADE TESTS: Repeated applications of brakes from 45 mph to 30 mph at deceleration rate of 7 ft/sec² produced these pedal effort patterns:



NOSE DIP ON BRAKING: At a steady deceleration rate of 21 ft/sec², body diving angle was 1¼° for Corvair, 2° for Falcon.

PARKING BRAKE TESTS. When brake was applied suddenly from 20 mph true speed car stopping distance was 31 ft. for the Falcon. Parking brake stopping distance not tested on Corvair because ratchet design required two strokes, and there was no quick release on handle.

CHASSIS DYNAMOMETER HORSEPOWER (tests made by Clark Automotive Service, Chicago.) Temperatures 60-67°F; relative humidities 55-63%; Barometer 29.6 in. Hg.

CORVAIR				FALCON		
Engine RPM	2400	2900	3400	2000	2500	3000
Horsepower	30.0	37.5	39.0	27.9	35.1	39.0

HORSEPOWER at REAR AXLE. Values calculated from acceleration data with allowances made for inefficiencies and rotational inertia:

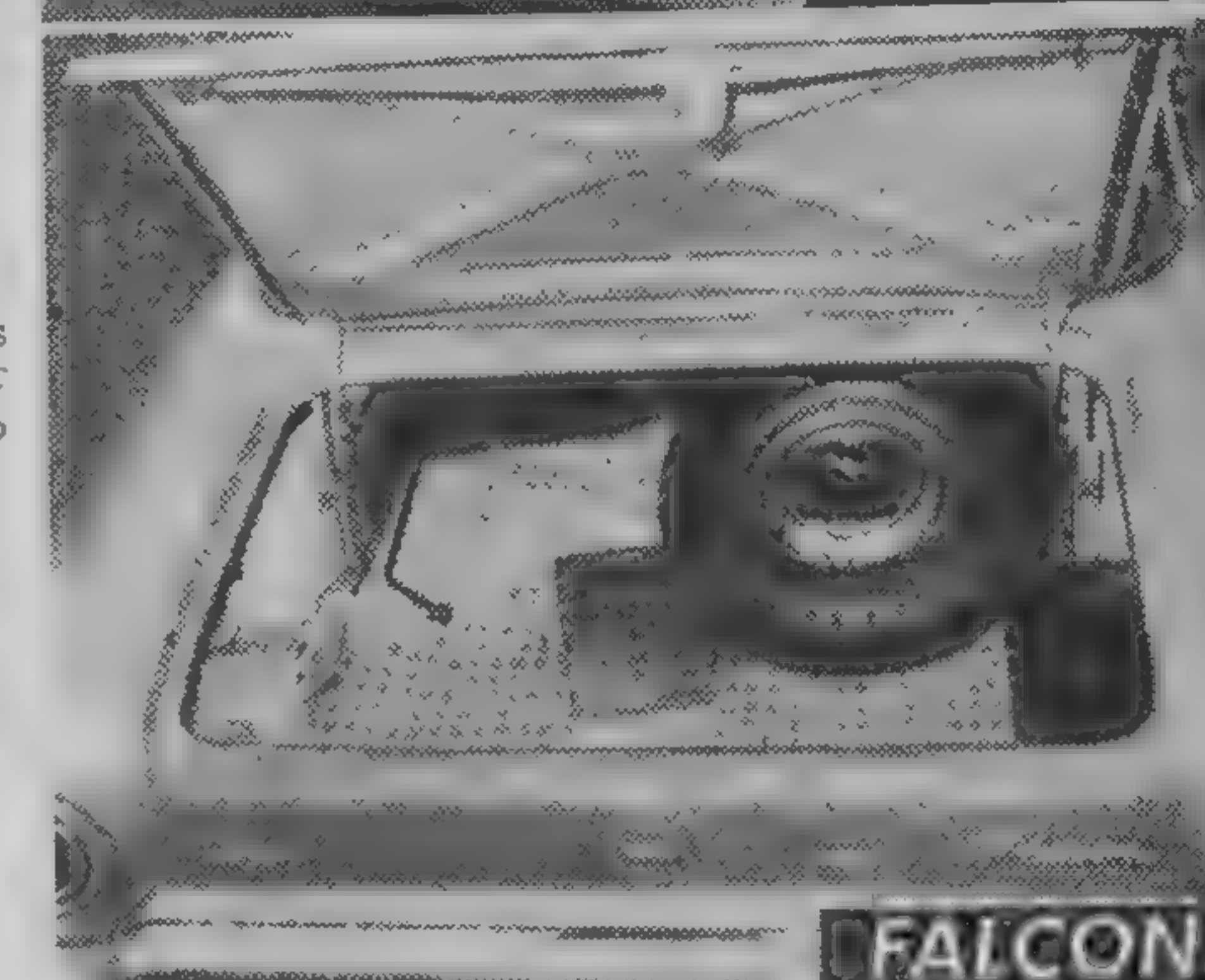
CORVAIR			FALCON		
Engine RPM	Equiv. Torque lb. ft.	Axle HP	Engine RPM	Equiv. Torque lb. ft.	Axle HP
3600	72.7	49.8	3600	79.0	54.1
3100	81.3	48.0	3100	86.9	51.3
2600	86.8	43.0	2600	94.3	46.7

Advertised engine HP reaching the rear wheels:

	CORVAIR	FALCON
HP	49.8	54.4
%	62.3	60.4



CORVAIR



FALCON

You'll travel lighter in a compact car, that's for sure. Above, Corvair's front luggage compartment with one suitcase in place. Below, Falcon's trunk is roomier, but tall suitcases will still have to store flat.

miles on five gallons, as compared with the 79.9 miles racked up by our 1959 test Ford.

Using regular gas at 32c a gallon, our test Corvair could log about a year's worth of driving (some 10,000 miles) for \$183 in gasoline costs. The same figure for our test Falcon would be \$141.

In short, buy a compact car and baby will still get his new shoes.

Handling. With both these new compacts, there's a very refreshing feeling of being in charge of the driving once more. You don't have to relay your driving instructions through a mess of automatic machinery and wait for it to do the job. Handling is sensitive and responsive, and cornering is trim.

For gunning around sharp mountain turns, traffic acrobatics or maneuvering over slick surfaces, however, we'll take the Corvair over the Falcon. Those independent rear axles have low inertia and seem to hug the ground even over sharp, high bumps. On slick pavement the Corvair steers very easily with the throttle, and the rear wheel traction is superb.

That's all very well, you say, but how will she behave at high speeds in a cross wind? Will that light front end tend to wander? At first we thought so, when our

Test Car Measurements and Specifications

	CORVAIR 700	FALCON Deluxe
Engine type	Air-cooled OHV-6	Water-cooled
Bore and stroke	Horizontally-opposed	I-head 6 in-line
Adv. max. horsepower	3.375 x 2.60	3.50 x 2.50
Adv. max. torque	80 @ 4400	90 @ 4200
Mean effective pressure (lb./in. ² @ rpm)	125 @ 2400	138 @ 2000
Compression ratio	134.6 @ 2400	144.0 @ 2000
Piston displacement (cu. in.)	8.0:1	8.7:1
Turning circle (ft., curb-to-curb)	140	144.3
Overall steering ratio	38.7	38.8
Torque to turn (lb. ft.)	23.5:1	27:1
No. of turns (lk-lk)	6.5	12.
Wheelbase (in.)	5.2	4.5
Overall length (in.)	108	109.5
Overall width (in.)	177.5	181.3
Unloaded O.A. height (in.)	65.5	67.5
Min. car-to-road clearance (in.)	51	56.2
and location	6.5—bolts in belly structure	6.2—front lower A-frame
Worst hump car will clear	17 ft. radius	14 ft. radius
Max. driveway angle car will clear	19°	20° rear
Highest curb doors will clear	12 inches	13.2 inches
Highest curb front bumper will clear	11 inches	14 inches
Inches of overhang (Front and Rear)	30.2-41.8	30-41.8
Door width opening	Front 33	43.3
clearance (inches)	Rear 31.3	(None—2 dr.)
Headroom (inches)	Front 34.5	34
	Rear 34	32.2
Front legroom (inches)	42.5	44
Rear kneeroom (inches)	8-12.5	9.2-13.2
Rear seat (inches)	18	16.7
Hiproom (inches)	Front 51.5	53.5
	Rear 50.5	56
Seat height (inches)	Front 10.8	11
	Rear 11.3	14
Shoulder room (inches)	Front 53.8	55
	Rear 53.9	54.5
Windshield (sq. in.)	1177	1242
Rear window (sq. in.)	1120	1204
Driver's eye-to-road distance (ft. & in.)	Left Side 21'4 1/2"	21'9"
	Center 21'2 1/2"	24'1"
	Right Side 26'2 1/2"	25'3"
Tire size and ply	6.50 x 13-4	6.00 x 13-4
Gas tank capacity (gals.)	11	14
Oil fill capacity (qts.)	4	3.5
Radiator capacity (qts.)	None	9.3
Transmission capacity (pts.)	6	2 1/2
Luggage compartment (cu. ft.)	10.2 front	23
	3.5 inside	
Luggage lifting height (inches)	30.7	30.8

test Corvair developed a shudder between 45 and 55 mph in a cross wind. A careful inspection showed us this was caused by a defective ball joint in the front suspension. Then a test with a second Corvair, in cross winds up to 40 mph, revealed no instability—in fact, we couldn't even induce it with whip turns. The only time anyone is likely to get an uneasy feeling with this car is when it comes out of a dip fast, so that the load is entirely removed from the front wheels (see photo). Come to think of it, that condition is enough to make the driver of any car uneasy. If a front tire blew out suddenly, we would guess that your chances of controlling

the car would be better in a Corvair, with no heavy engine weight bearing down on the flat tire.

In our brake fade tests on the Big Three last year, not one of the cars showed a doubling of pedal pressure in 12 successive panic stops. In contrast, the pedal pressure of the Corvair's brakes doubled from 12 pounds to 24 pounds in seven test stops. And the Falcon's 24-pound pedal pressure doubled in nine stops. While these results should not be considered a serious record of fading, it indicates that some braking improvements will probably be made on the 1961 models, if not before.

If you are curious about what happens when a heavy rain beats against the Corvair's rear engine compartment louvers, the answer is, nothing of consequence. The waterproof drain system diverts the water neatly away from the engine. Our test Corvair did leak considerably at a misfit wing vent and at the top of the right rear door, where the factory only installed half of the weather seal. But no water entered the forward luggage compartment. The Falcon leaked badly around the left side of the instrument panel, but elsewhere was watertight.

Exploring Space. Contrary to earlier reports based on some faulty



Left, Swing-axled Corvair

manufacturer's specifications, the Corvair is not much better than the Falcon in headroom in the front and the tune of one-half inch in the rear, because of the Falcon's broader beams, with five and one-half inches front and five and one-half in the rear. The Falcon's headroom is a moderate of the long-legged front seat legroom and kneeroom.

Corvair's two luggage compartments, front hood and one behind

Calculated Performance Factors

	CORVAIR	FALCON
True MPH at speed of max. advertised horsepower*	84.6	92.7
True MPH at speed of max. advertised torque	45.0	43.5
Engine rpm at 60 mph (also rev. per mile)**	3100	2740
Average piston speed at 60 mph (also ft./mile)**	1343	1142
Cu. ft. per minute of mixture at 60 mph (also cu.ft./mile)—a theoretical measure of fuel economy—low values desirable	125.7	114.7
Max. engine horsepower (adv) per ton of car (curb wt.)—a theoretical measure of acceleration performance—high values desirable	64.7	76.0
Max. engine horsepower (adv) per cu. in. displacement—a measure of design excellence in producing power—high values desirable	0.572	0.623
Power performance factor (a weighted average of CR, displacement and curb wt.). This is a theoretical measure of potential acceleration	94.5	107.0
Reciprocating load factor at 60 mph (based on piston weight, bore, stroke, rpm)**	1060	920

* Values based on manufacturer's advertised horsepower subject to variation due to difference in rating techniques.

** Lower values generally indicate less wear and stress on the engine.

Above data and signed certification are reproduced from test reports.

CERTIFICATION

I certify that the test results in this report are the actual findings obtained in tests, conducted in accordance with good engineering practice, on the automobiles named and under the conditions specified.

Edw J Chert

Member, Society of Automotive Engineers, American Society of Mechanical Engineers, Director, Automotive Research Laboratories, Professional Engineering Consultants.



LIKE to relax after a day? Take this Ace engine in the trunk. The fishing spot, because the power an outboard motor

Key to the new 4-cycle engine with a 4-ernor. Using only half of the mower shell, at propeller unit and cor board motor in a 43 inches high and w

The mechanical gov

ld be better in a Corvair, by engine weight bearing a flat tire.

ke fade tests on the Big ear, not one of the cars ubling of pedal pressure ive panic stops. In con- dal pressure of the Cor- doubled from 12 pounds in seven test stops. And 24-pound pedal pressure nine stops. While these ld not be considered a d of fading, it indicates aking improvements will made on the 1961 mod- fore.

curious about what hap- heavy rain beats against rear engine compart- , the answer is, nothing nce. The waterproof diverts the water neat- n the engine. Our test leak considerably at a vent and at the top of r door, where the fac- alled half of the weath- no water entered the age compartment. The l badly around the left instrument panel, but s watertight.

pace. Contrary to s based on some faulty

ctors

	CORVAIR	FALCON
	84.6	92.7
	45.0	43.5
	3100	2740
	1343	1142
tical	125.7	114.7
tical	64.7	76.0
de-	0.572	0.623
and	94.5	107.0
oke,	1060	920
variation due to difference in		

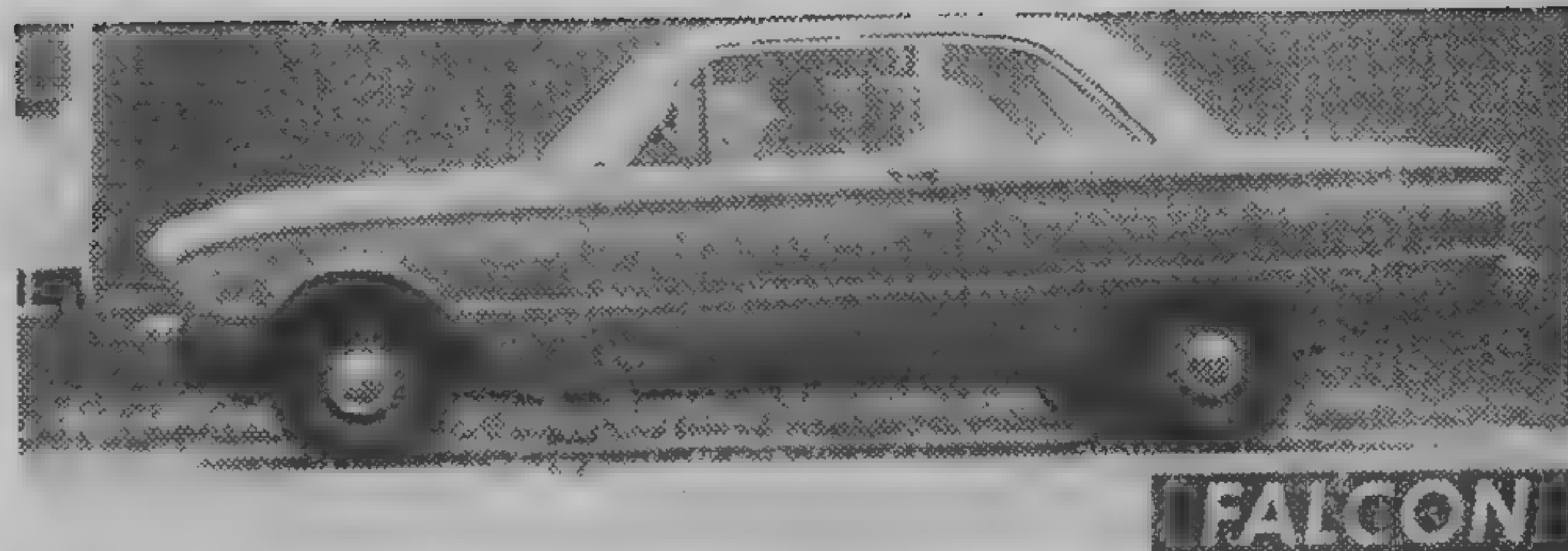
e the actual findings obtained engineering practice, on the specified.

7 @ert

peers, American So- or, Automotive Re- engineering Consultants.



Left, Swing-axled Corvair is very sure-wheeled on fast turns. Right, The Falcon's braking dip was a mild 2°. Corvair's was an even milder 1¼°.



manufacturer's specifications, the headroom in the Corvair is not much more generous than the headroom in the Falcon. It is better, however, to the tune of one-half inch in front and 1.8 inches in the rear, because its seats are lower than Falcon's. The Falcon will accommodate the broader beams, with two inches more hiproom up front and five and one-half inches more hiproom in the rear. The Falcon is also a bit more considerate of the long-legged, with 1½ inches more front seat legroom and 1.2 inches more rear seat kneeroom.

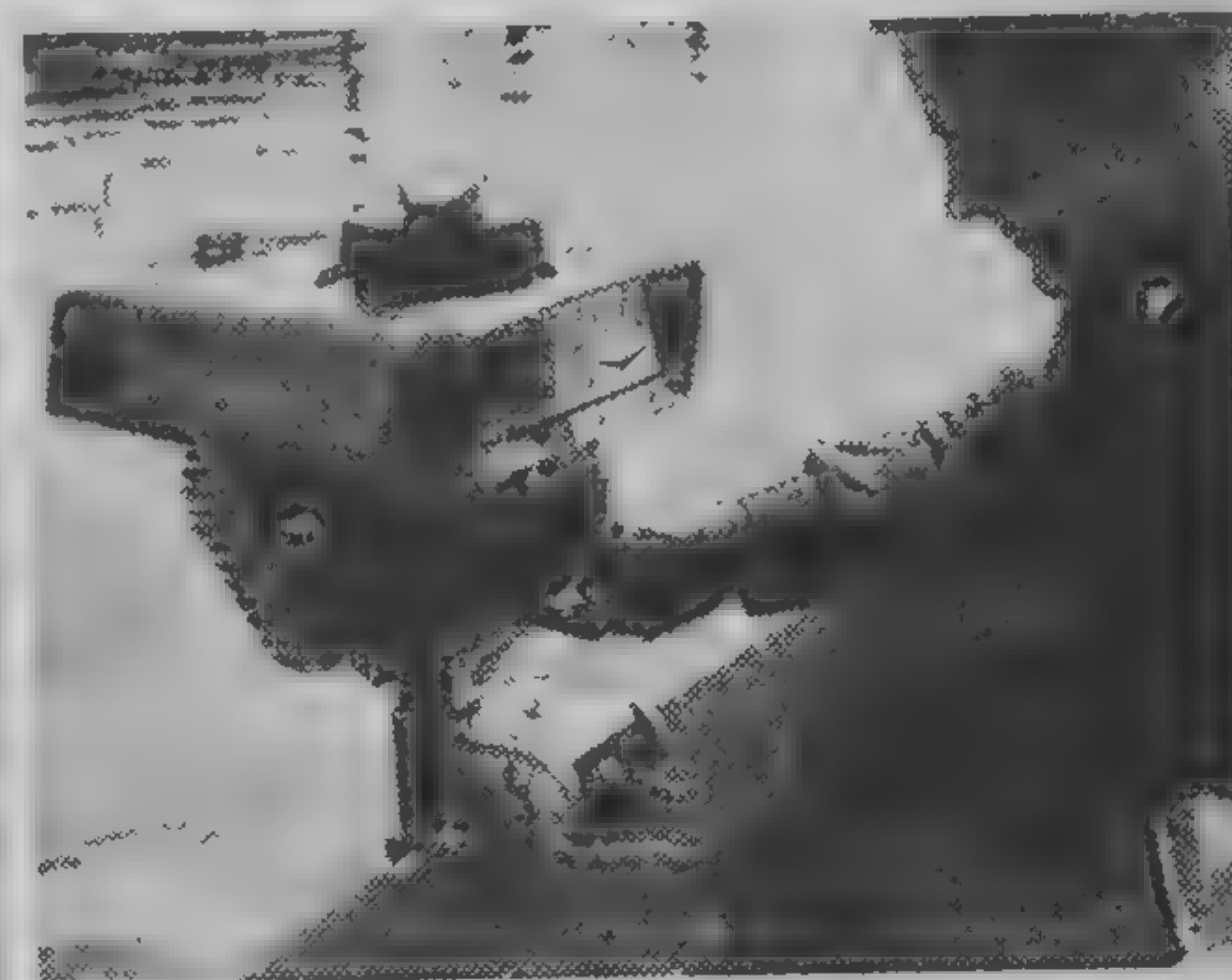
Corvair's two luggage areas—one under the front hood and one behind the rear seat—provide

a total of 13.5 cu. ft. of storage space. The Falcon's single trunk in the rear provides 23 cu. ft. for luggage, and the wife can undoubtedly put that extra cubic footage to good use when she packs for the next trip.

Suggested factory list price of the Corvair 700 4-door sedan is \$2,103, and the Falcon Deluxe 2-door sedan is pegged at \$1,912. To these prices you will have to add the federal and state taxes, dealer delivery-and-handling charges, transportation costs, and optional equipment costs.

Then you can start dickering in earnest, providing, of course, the short supply situation caused by the steel strike has let up by that time.

Convertible "Outboard Mower" Has a Split Personality



After removing cutter blade, take the engine out of the mower shell as shown at left. Attach heat exchanger unit to top of engine and propeller unit to bottom, and you have a 2½-hp outboard motor (right).

LIKE to relax after mowing the lawn on a hot day? Take this Acco mower apart and put the engine in the trunk. Then head for your favorite fishing spot, because that mower engine will also power an outboard motor.

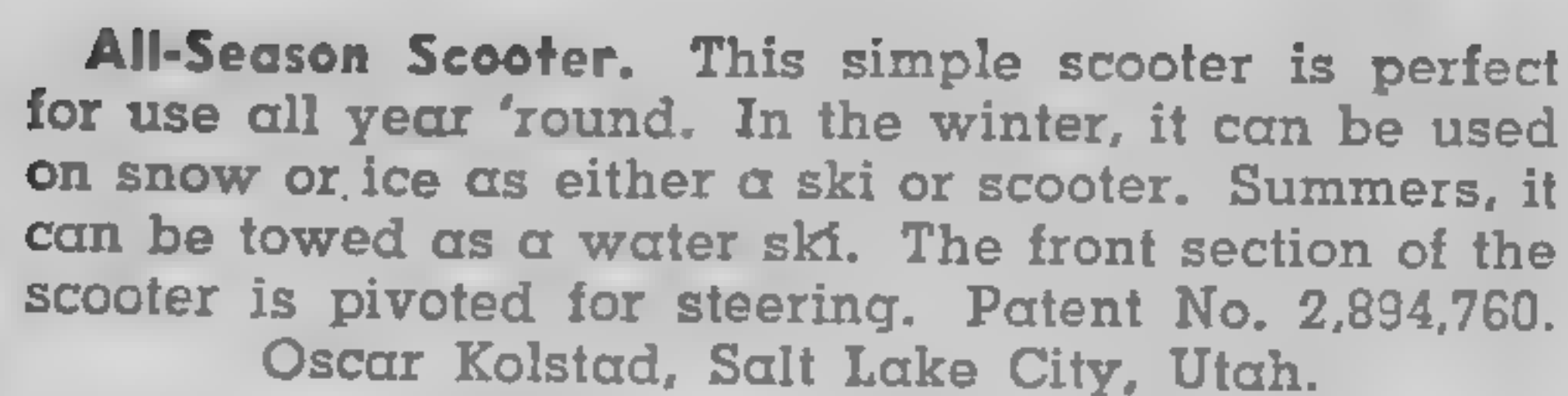
Key to the new convertible unit is a 2½-hp, 4-cycle engine with a new-type mechanical governor. Using only hand tools, you can take it out of the mower shell, attach a heat exchanger and propeller unit and convert it into a trolling outboard motor in a matter of minutes. The rig is 43 inches high and weighs 43 pounds.

The mechanical governor replaces the conven-

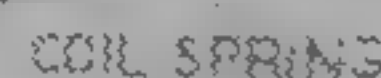
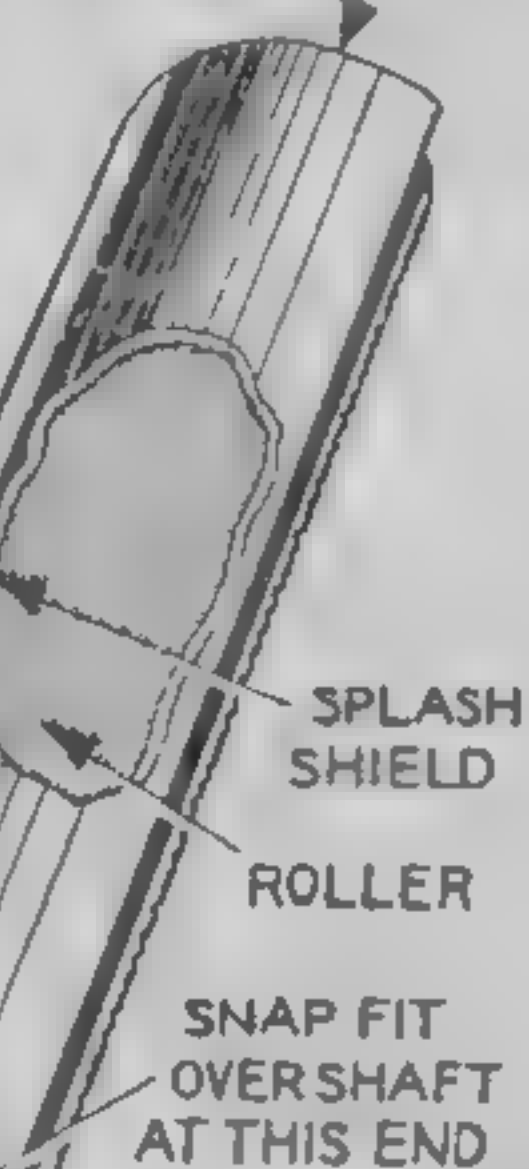
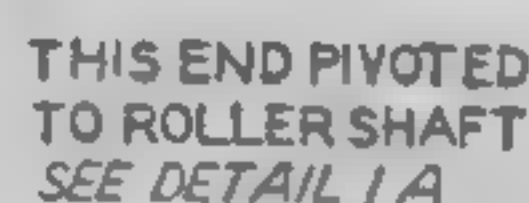
tional vane-type usually found on gas-powered mower engines. It permits a drop of as little as 300 rpm before throwing the throttle wide open for more power surge. As a result, says the manufacturer, it provides up to 30% more usable power to the shaft, keeping the motor at its optimum speed of 3600 rpm to maintain a propeller speed of 2400 rpm. The engine has an impulse type starter for automatic starting.

The entire rig—engine, plus mower and outboard motor accessories—will sell for about \$150, says the builder, American Chain and Cable Co., Inc., Bridgeport, Conn.

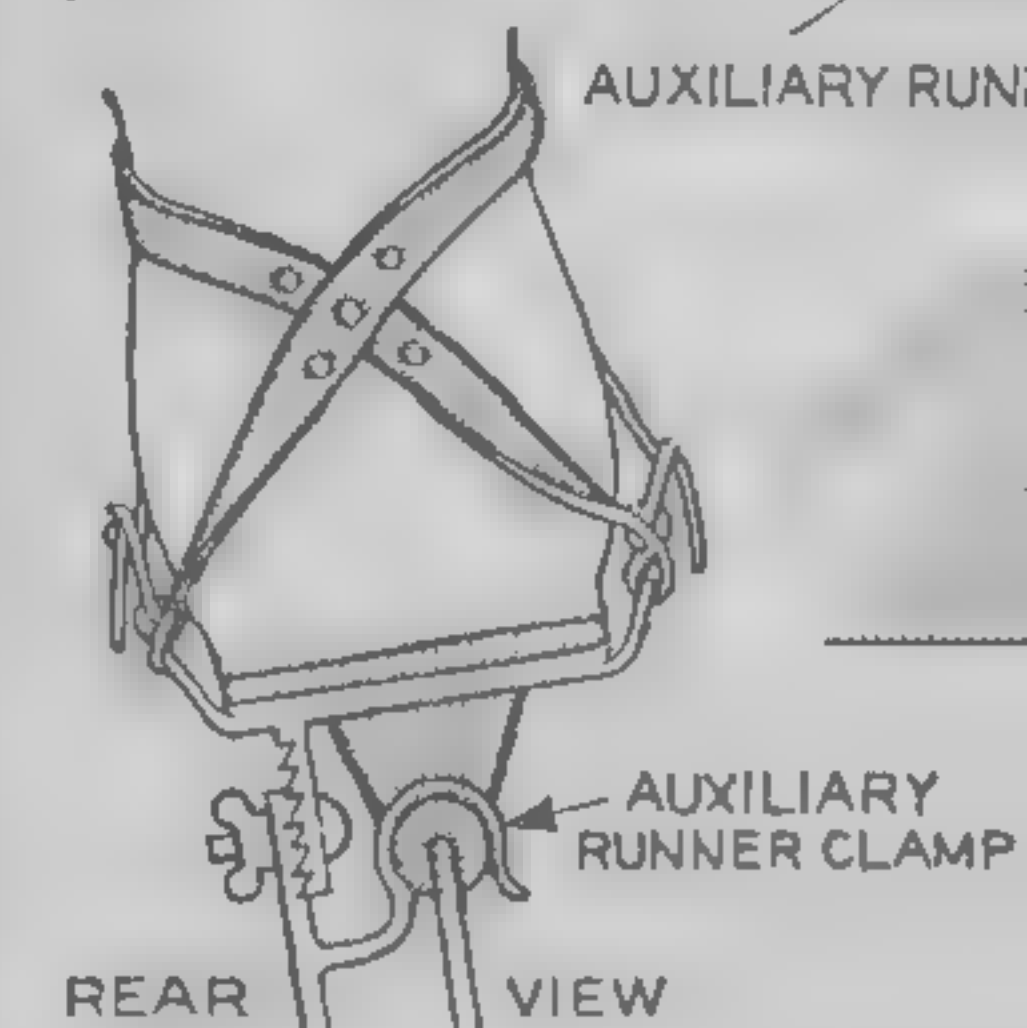
New



Candied Teething Ring. Babies will be sure to like this new teething ring, which combines the traditional ring design with a slow-dissolving—and good-tasting—candy lozenge. The lozenge, which can be made of any kind of hard sugar candy, slips snugly into the rubber slot at the business end of the ring, as shown in the cross-section drawing. Patent No. 2,826,201. John R. Yoder, Fullerton, Pa.



Child-Proof Cupboard Lock slips securely over the handles or knobs of adjoining cupboard or cabinet doors. Extremely simple in construction, it is strong enough to resist the efforts of an inquisitive child, but is easily removed by an adult. Patent No. 2,899,229. Joan M. Jenks, St. Paul, Minn.



Ankle Saver is designed for the novice ice skater. An auxiliary device which fits onto the skate blade to the rescue if the skater's ankle gives out. U.S. Patent No. 2,867,445. Price \$1.95. Winsted, Conn.



Toy Bubble Gun. Dip the hollow rubber pistol gun in the solution to blow bubbles. Patent No. 2,882,611, St. Louis, Mo.; John R. Doan. Nicholas C. Spanos, New York City. **Hollyw**

● For more complete information on the conditions shown here, you may obtain a patent by sending your request to the Commissioner of Patents, Washington 25, D. C. Enclosed is a list of the

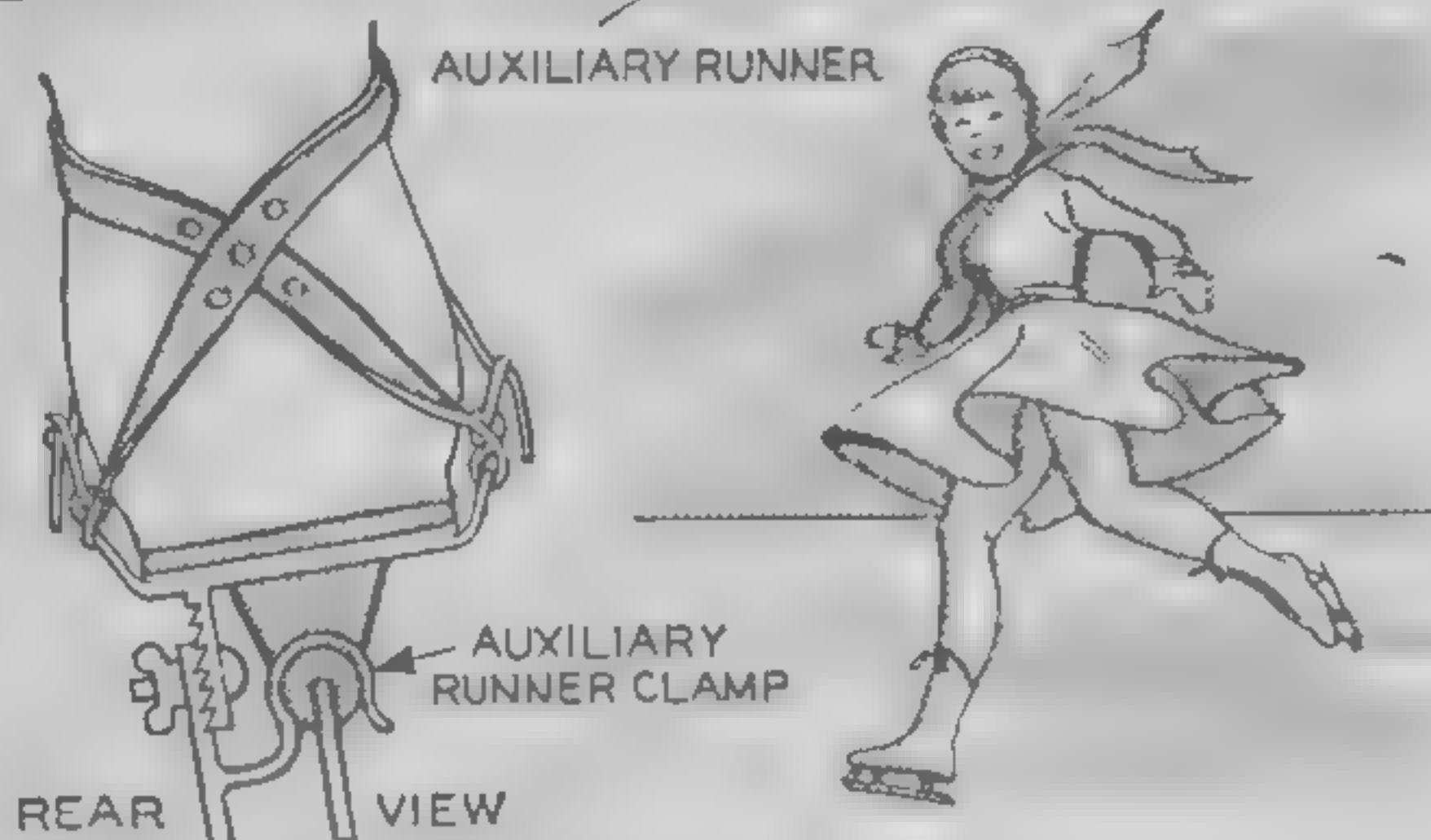
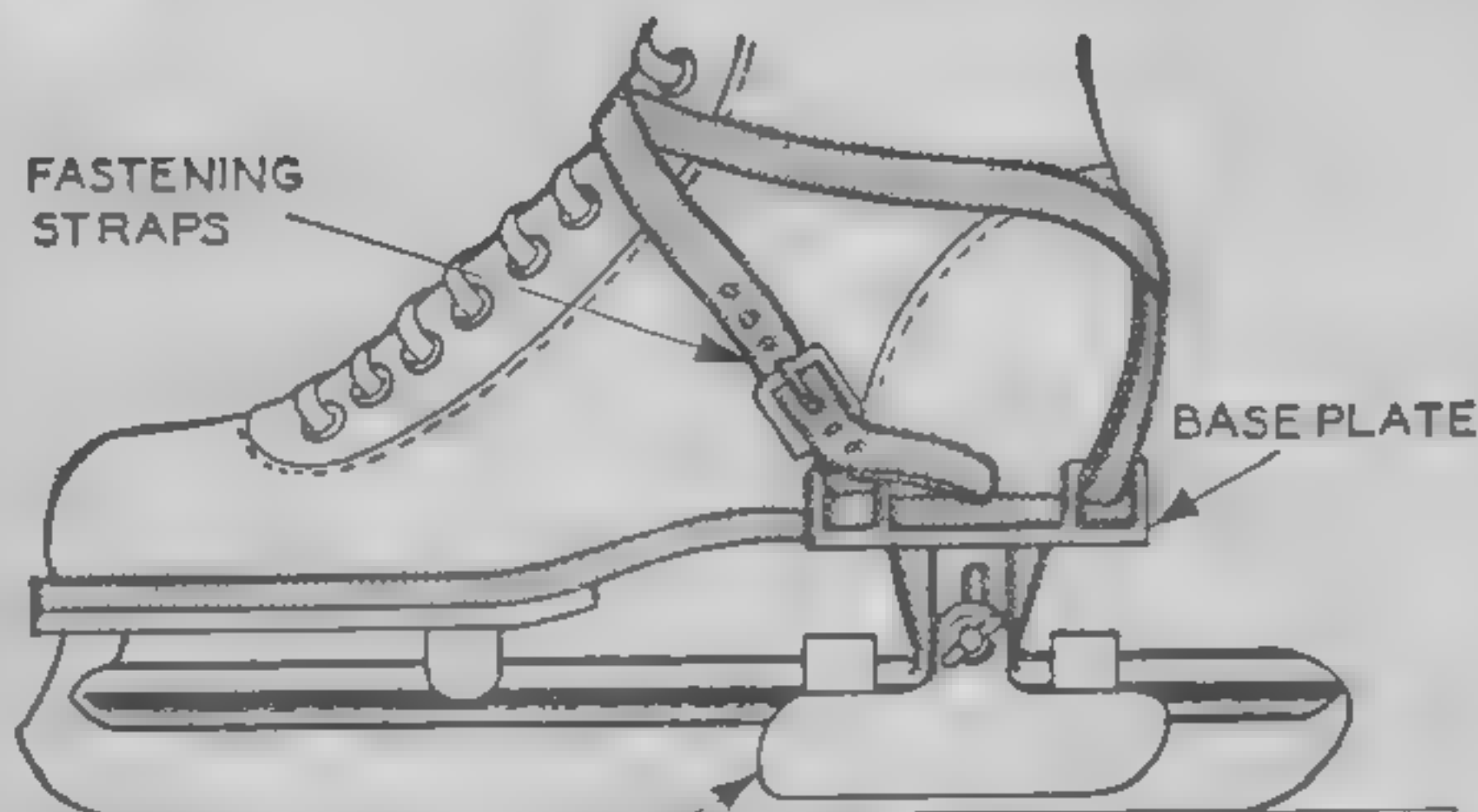
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New Patents

This simple scooter is perfect in the winter, it can be used as a ski or scooter. Summers, it is a ski. The front section of the scooter is perfect for the winter. Patent No. 2,894,760. Salt Lake City, Utah.



Teething Ring. Babies will be using this new teething ring, which is a traditional ring design with a hard candy insert. The lozenge, which can be used for any kind of hard sugar candy, is inserted into the rubber slot at the top of the ring, as shown in the drawing. Patent No. 2,826,445. R. Yoder, Fullerton, Pa.

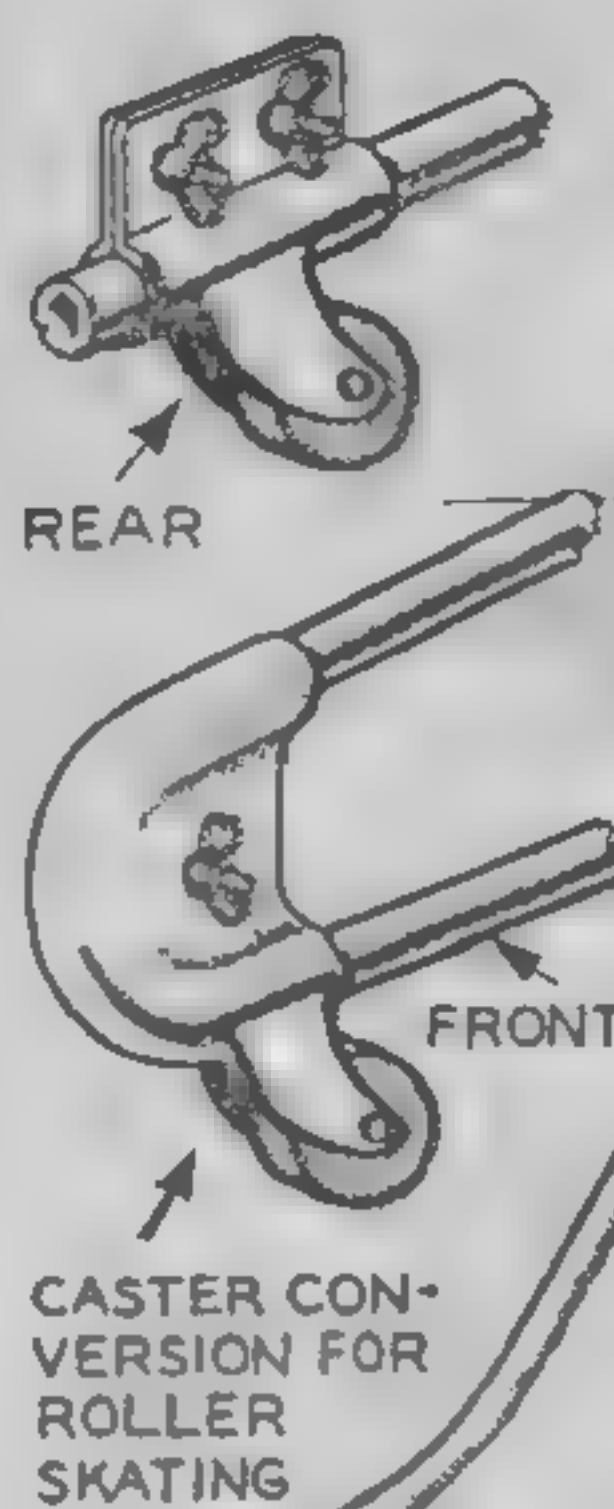


Ankle Saver is designed to aid the novice ice skater. An auxiliary runner which fits onto the skate blade, it comes to the rescue if the skater's ankle weakens. Patent No. 2,867,445. Paul J. Lachat, Winsted, Conn.

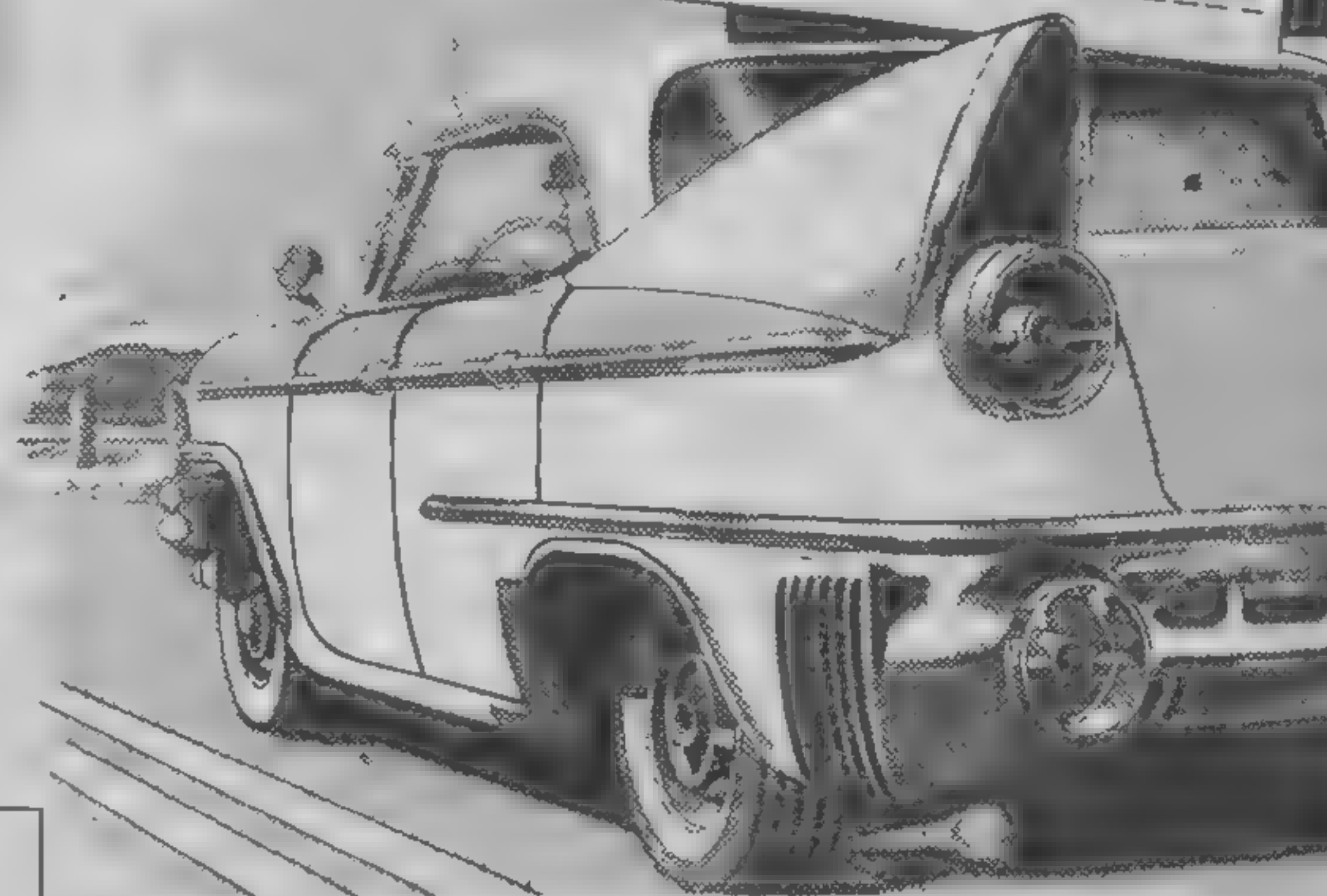
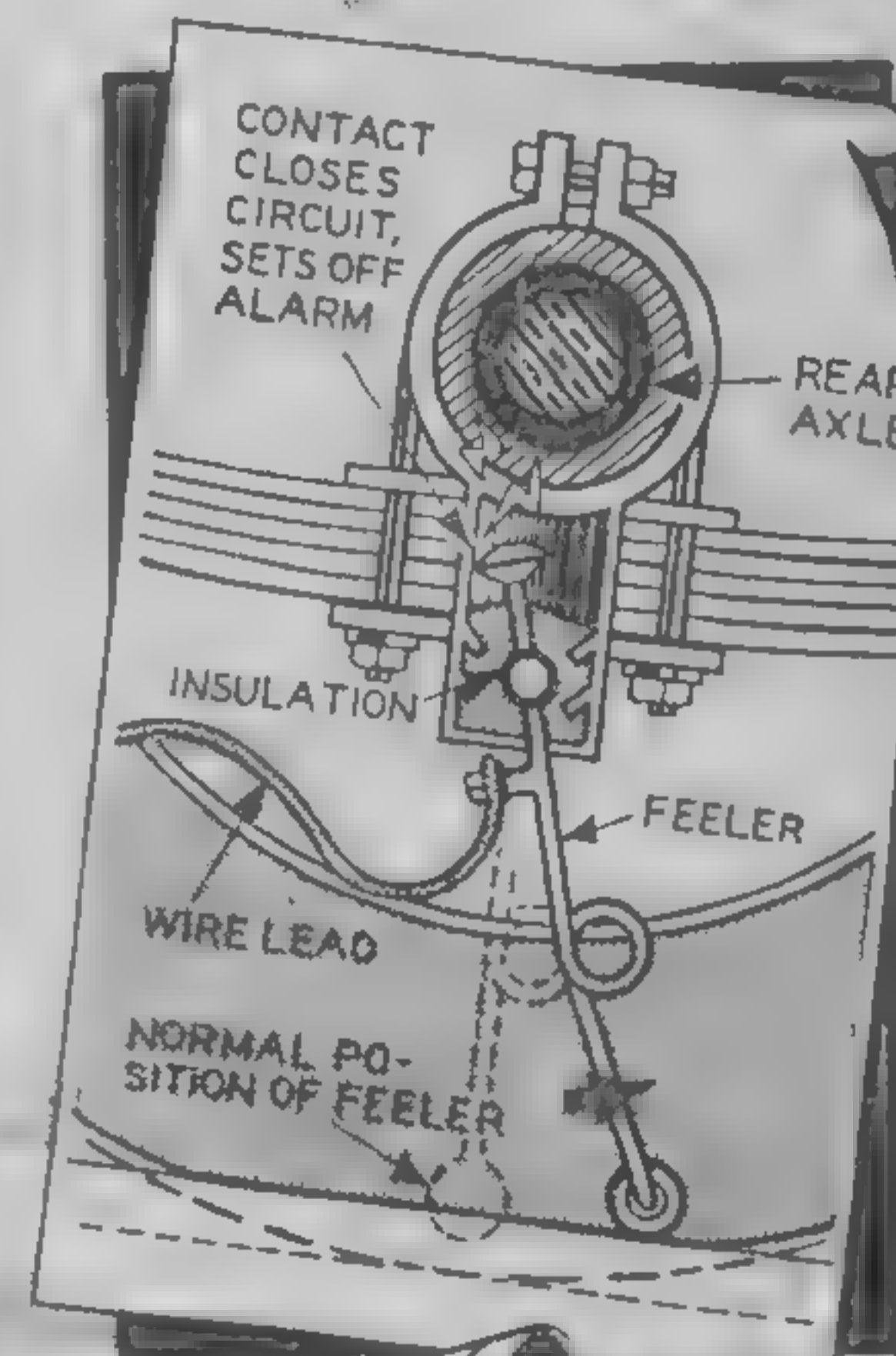


Toy Bubble Gun. Dip the hollow ring in suds, squeeze the hollow rubber pistol grip and get bigger and better bubbles. Patent No. 2,882,643. Alexander G. Jianas, Kansas City, Mo.; John R. Dos Passos, Westmoreland, Va.; Nicholas C. Spanos, New York City, and Gene Towne, Hollywood, Calif.

• For more complete information on any of the inventions shown here, you may order copies of each original patent by sending your request with the patent number to Commissioner of Patents, Department of Commerce, Washington 25, D. C. Enclose 25¢ in cash for each patent.



Skating Trainer. Ice or concrete will hold no terror for beginning ice- or roller-skaters if they make use of this handy training aid, designed to save skinned knees and torn clothing. Casters are easily attached for trial spins on dry land, and the entire device can be quickly knocked down for storage or carrying. Patent No. 2,900,008. Harold B. Seger, Wheat Ridge, Colo.



Soft Tire Warner. Many a perfectly good automobile tire has had its walls ruined by being driven while underinflated. This invention immediately warns the driver if pressure in his tires is not adequate—either by flashing a warning light or, preferably, by sounding a horn. Patent No. 2,882,362. Alton L. Carter, Corpus Christi, Texas.

Up-and-Down Wiper Clears Entire Windshield

BLIND spots caused by snow or rain accumulating on the windshield are ended by this up-and-down wiper that extends the full width of the glass.

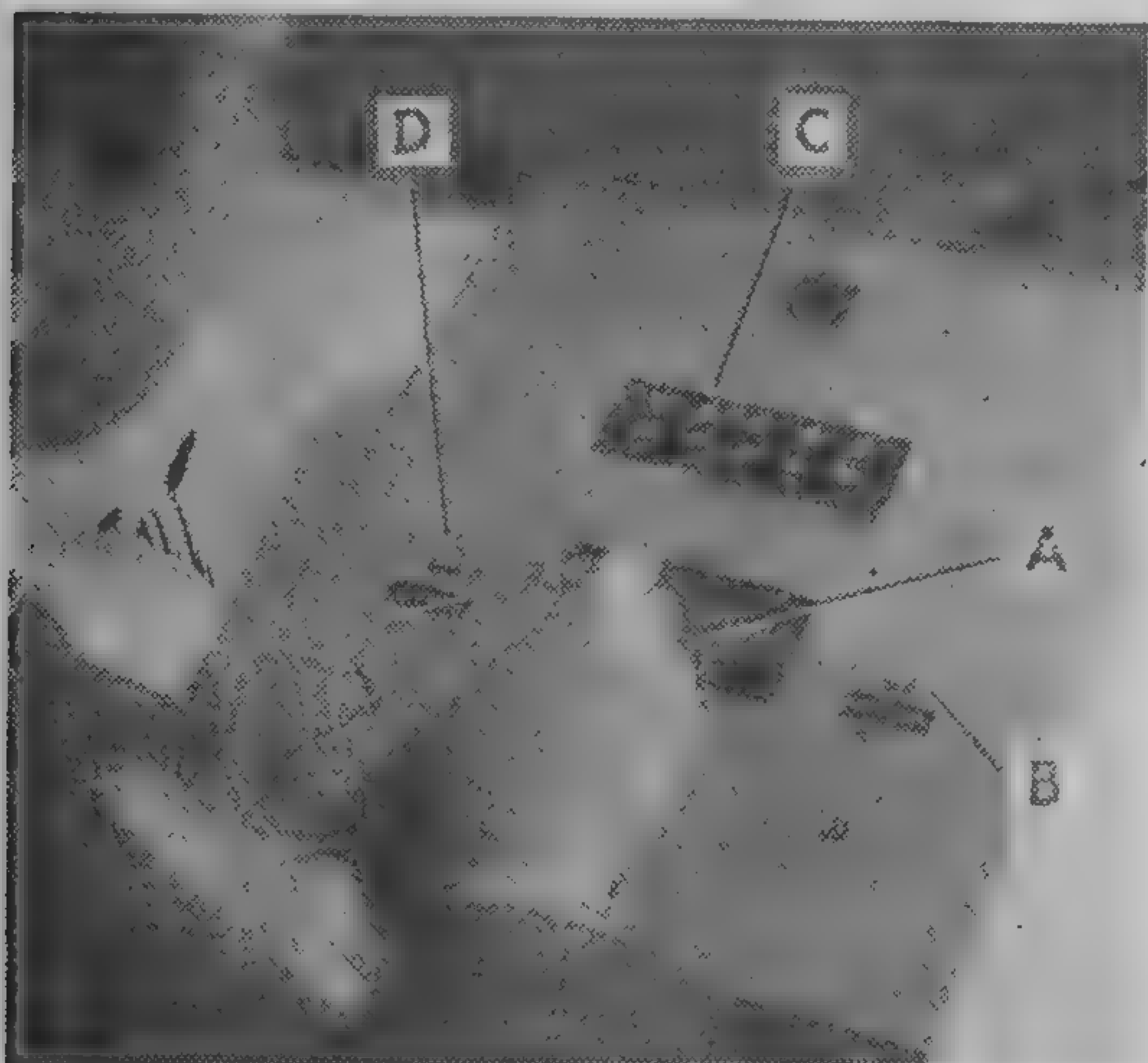
The wiper is operated by a threaded spindle—much like the lever wind mechanism on a fisherman's casting reel—and pulls the snow or water down into a trough below the hood level.

You might be seeing this new invention, which received U. S. Patent No. 2, 880,444, on some German cars in the future. Its inventors, Béla Bárány, of Stuttgart-Rohr, and Karl Wilfert, of Stuttgart-Degerloch, assigned it to Daimler-Benz, A. G., of Stuttgart-Unterturkheim, Germany.

New Machine "Reads" Handwriting

CAN'T read your own handwriting? Maybe the electronic device in the picture can.

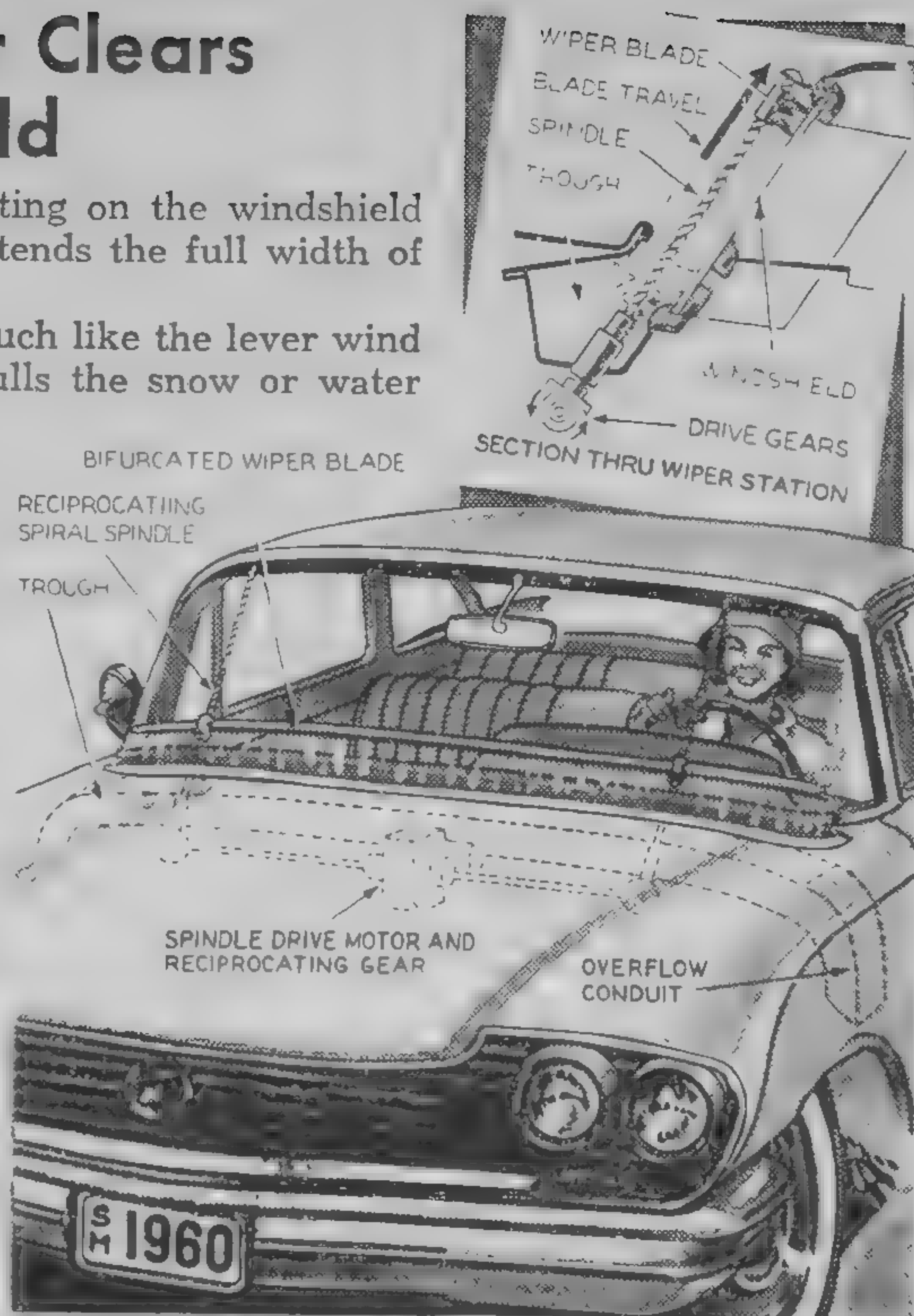
It has a 10-word vocabulary—"zero" through "nine," spelled out. It was invented to demonstrate methods which might be used in larger machines that could read a wider variety of material. Such machines would be valuable in busi-



To use handwriting reader, the writer moves metal stylus over a special surface (A). Then when he touches "Identify" button (B) with the stylus, a light appears on the panel (C) by the numeral corresponding to the word he has just written. Then he touches "Reset" button (D) before writing more.

nesses where information now has to be translated into machine language by punched cards, by tape or by pressing adding machine or typewriter keys.

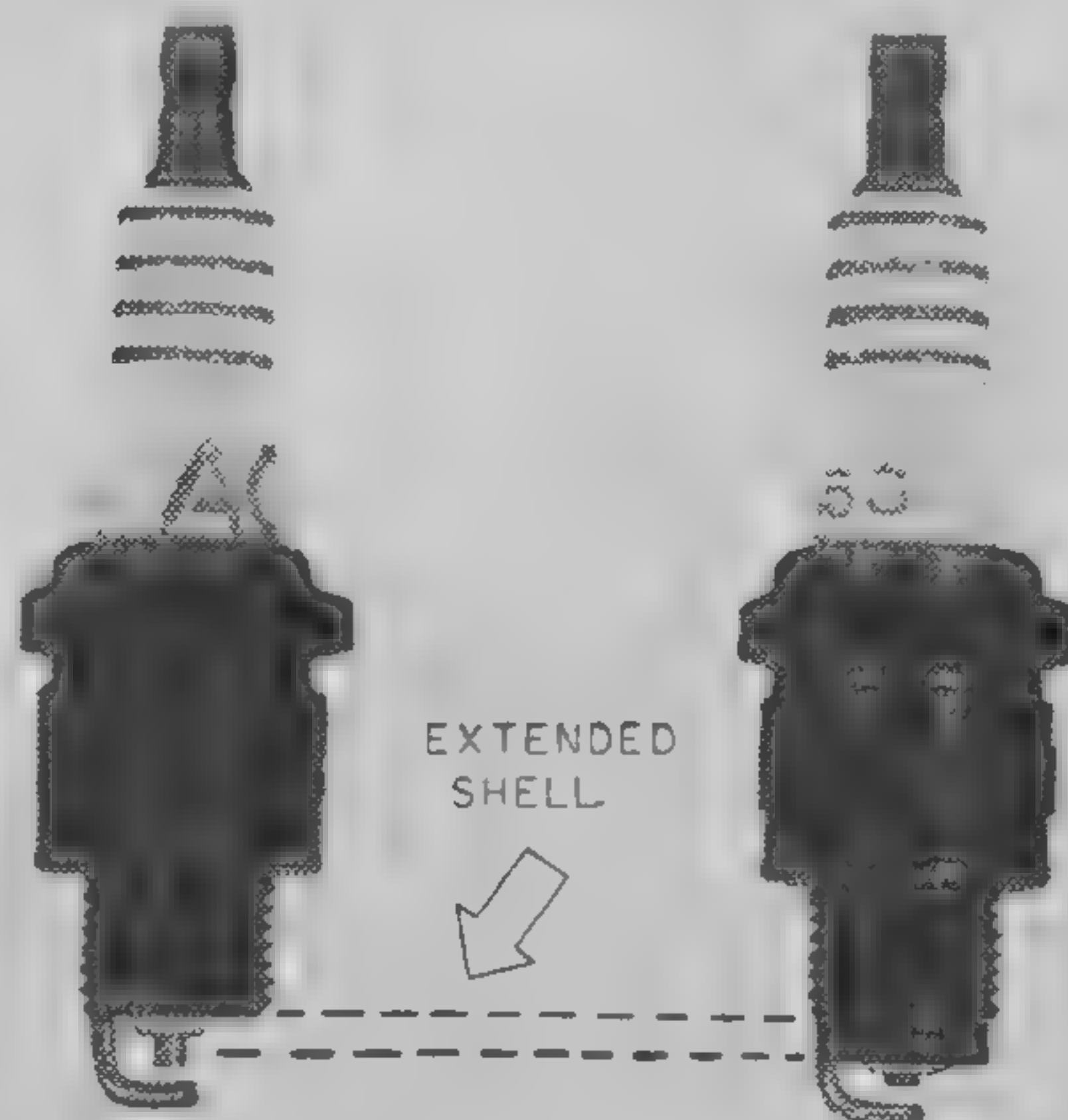
The experimental device, developed by Bell Telephone Laboratories, New York City, has one limitation. The user must write within limits on a special surface, so the wired stylus will make electrical contact with 15 horizontal metal strips sandwiched alternately between strips of electrical insulating material.



"Extended Shell" Spark Plug Ends Side Wire Burn

A NEWLY-designed "extended shell" spark plug eliminates the side wire burning and excessive gap growth characteristics that often resulted from "extended tip" plugs.

The new plug, developed by AC Spark Plug Division of General Motors, Flint, Mich., has a small collar (see plug at right in photo). This means the side electrode wire can be shortened, while the point of ignition remains deep in the combustion chamber. In extended tip plugs, extreme length of the side wire results in greater exposure to high cylinder temperatures.



Fiat's finned aluminum brake drums panic-stop her fast with little applied force and almost no delay. Note the transparent plastic wind deflector on dashboard frame which keeps the back seat pleasantly dry and free.

IF YOU'RE a car commuter—a fellow whose nerves cry for tranquilizers during the daily traffic-dodging—this sprightly little Fiat should keep your pill box in hand.

The 600 has outstanding traffic maneuverability, cruises adequately at expressway speeds and comes equipped with American-style wrap-around bumpers to ward off the enemy. It's somewhat smaller than the cars, Volkswagen and substantially smaller than cars:

	Wheelbase
Fiat	79.3
VW	94.5
Renault	89.0
Corvair	108.0
Falcon	109.5
Valiant	106.5

No Gas Guzzler. H machine be and still qualify powercycle with glass 600 provides the answer my 11% better than VW, double Corvair's Falcon's.

A top speed of 60 mph but our test car did an expressway driving a strain on the engine. A rpm at 60, piston speed compared to 1200 fpm for

MAKE & MODEL	Engine Type	No. of cyl.	Adv. Max. Brake H
FIAT 600	In line OHV water-cooled	4	22 @ 4600
Wheel-base (in.)	O.A. Length (in.)	O.A. Width (in.)	O.A. Height (in.)
79.3	132	55.5	54.5
Headroom		Front Legroom	Kn
Front	Rear		
35.5	32.5	42	4
Driver's Eye-to-Road Distance			
Left	Center	Right	
12'3"	15'10"	15'4"	



Shell" Spark Wire Burn

extended shell" spark
de wire burning and
characteristics that often
" plugs.

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s, Flint, Mich., has a
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ire can be shortened,
remains deep in the
extended tip plugs, ex-
ire results in greater
temperatures.



Fiat's finned aluminum brake drums panic-stop her fast with little applied force and almost no dip. Note the transparent plastic wind deflector on door frame which keeps the back seat pleasantly draft-free.

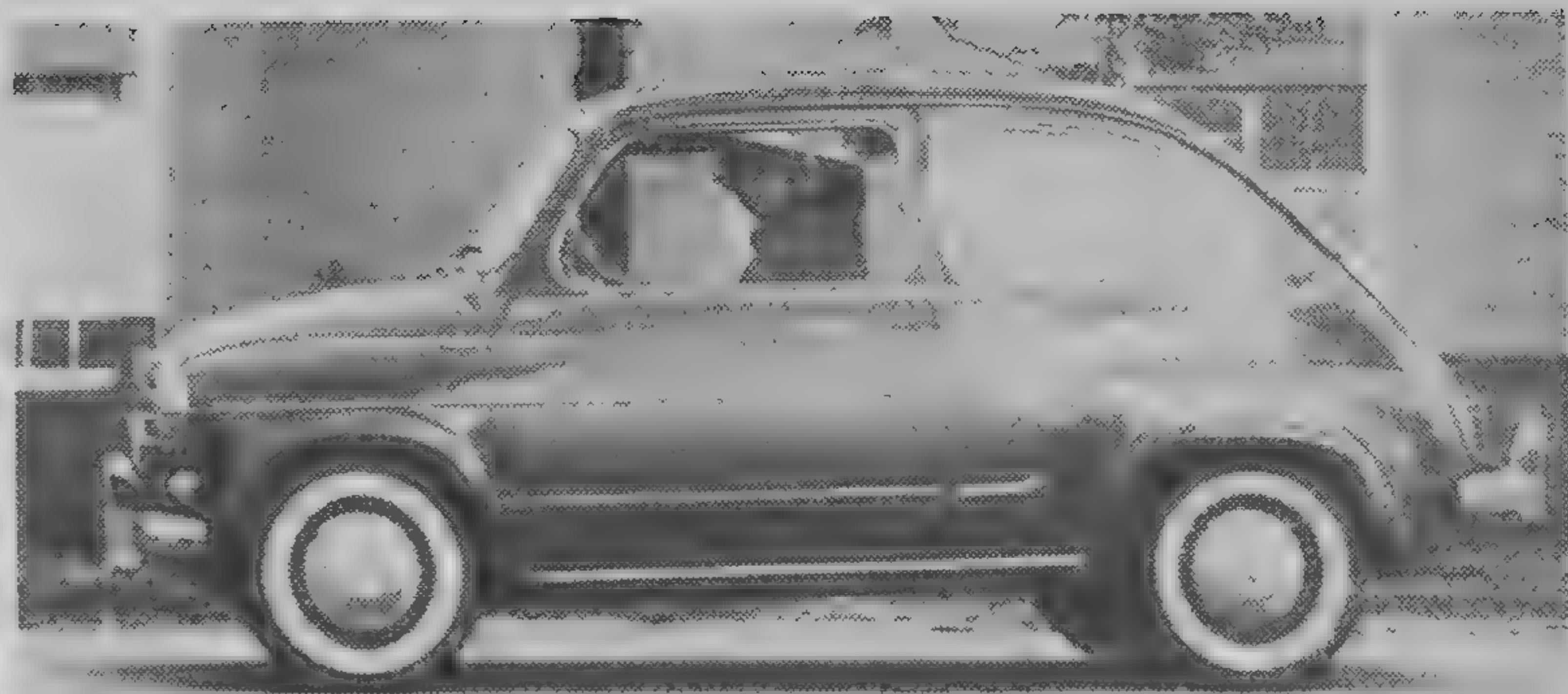
IF YOU'RE a car commuter—a fellow whose nerves cry for tranquilizers during the daily traffic-dodging—this sprightly little Fiat should keep your pill bill in hand.

The 600 has outstanding traffic maneuverability, cruises adequately at expressway speeds and comes equipped with American-style wrap-around bumpers to ward off the enemy. It's somewhat smaller than the other two leading small cars, Volkswagen and Renault Dauphine, and substantially smaller than the new U. S. compact cars:

	Wheelbase	O.A. Length	Curb Weight
Fiat	79.3	132.0	1325
VW	94.5	160.0	1610
Renault	89.0	155.0	1450
Corvair	108.0	180.0	2415
Falcon	109.5	181.1	2396
Valiant	106.5	184.0	2760

No Gas Guzzler. How economical can a machine be and still qualify as a car—rather than a powercycle with glass bubble attached? The Fiat 600 provides the answer with overall fuel economy 11% better than Renault, 50% better than VW, double Corvair's and 40% better than Falcon's.

A top speed of 60 *mph* is all the factory claims, but our test car did an honest 64. And prolonged expressway driving at high speeds puts little strain on the engine. Although it is revving 4619 *rpm* at 60, piston speed is only 1694 *fpm* (compared to 1200 *fpm* for VW, 2115 for Renault, 1142



Performance Report on the Remarkable FIAT 600

for Falcon and 1343 for Corvair).

But like her small-car, low-horsepower sisters, Fiat (22 *hp*) had best be content to find its expressway lane and stay there, because at 60 *mph* there is very little reserve power for passing.

Unloaded, the 600 gets to 30 *mph* in 9.24 seconds, just about a second slower than VW or Renault, and to 50 *mph* in 26.7 seconds, about 6 seconds slower.

A Responsive Handler because of its overall steering ratio of 13, Fiat is comfortable at both low and high speeds. Boulevard riding is surprisingly smooth, considering her lightness, probably because of the low unsprung weight. Fiat uses light, 12-inch wheels and tires with finned aluminum brake drums and steel liners. It has a unit body and independent front suspension by A-frames on top and a transverse leaf spring on the bottom.

Her light weight and those brake drums, incidentally, carried Fiat through our brake fade test in the best form we have seen—12 decelera-

TEST CAR MEASUREMENTS and SPECIFICATIONS

MAKE & MODEL	Engine Type	No. of cyl.	Adv. Max. Brake HP	Adv. Max. Torque lb. ft. @ rpm	Mean Effec. Pressure lb. in. ² @ rpm	CR	Piston Displ. (cu. in.)	Fuel Spec.	Curb Wt. (lbs.) with 7 gal. oil and water	Trans- mission Type	Rear Axle Ratio	Turning Circle (ft.)	O.A. Steering Ratio (man.)	Steering Torque to turn (lb.ft.)	No. turns lk-lk
FIAT 600	In line OHV water-cooled	4	22 @ 4600	27 @ 2700	108 @ 2700	7.5	38.6	reg.	1325	4-speed manual synchro	3.375	30	13	7.8	3.5
Wheel-base (in.)	O.A. Length (in.)	O.A. Width (in.)	O.A. Height (in.)	Min. Ground Clearance (in.)	Worst Hump can clear radius (ft.)	Max. Driveway Angle Car will Clear	Highest Curb Doors clear (in.)	Highest Curb Bumper will clear (in.)	Overhang (in.)		Door Width opening clearance				
									Front	Rear					
79.3	132	55.5	54.5	8.5	6.6	18.2°	13.2	12.5	20.5	31	38.5				
Headroom Front Rear		Front Legroom	Rear Kneeroom	Rear Seat Depth	Hiproom Front Rear		Seat Height Front Rear		Shoulder Front	Room Rear	Max. Seat Travel Lat. Vert.		Vision Areas (sq. in.) Windshield Rr. Window		
35.5 32.5		42	4 to 7	17.5	17.5 bucket seat 50.5		11 13.7		44	43.2	3 0.7		560	400	
Driver's Eye-to-Road Distance				Tires		Battery	Gas Tank (gals.)	Oil Fill (qts.)	Rad. Cap. (qts.)	Trans. Cap. (qts.)	Trunk Dimensions (in.)		Luggage Lifting Height		
Left	Center	Right	Size	Ply							9.5 x 18.5 x 9.8		29.8		
12'3"	15'10"	15'4"	5.20 x 12	4	12 volt 32 AH	7.13	3.1	4.5	1.64						

MODEL: Fiat 600 2-door Sedan.

TEST DATES: Sept. 22, 1959 through Oct. 15, 1959.

GENERAL ROAD AND WEATHER CONDITIONS: Portland concrete, generally smooth and level; Fall weather; dry during tests; 55 to 80°F; 29.3 to 29.6 in. Hg.

MILEAGE AT START: 2950.

MILES COVERED: 770.

GAS: Regular. **OIL:** SAE 30.

CURB WEIGHT (with 10 gal gas): 1325 lb; 40.7% on front wheels; 59.3% on rear wheels.

TIRE PRESSURE: 14.2 psi front; 22.8 psi rear.

SPARK SETTING: 10° BTC at idle rpm.

REAR AXLE GEAR RATIO: 5.375 to 1.

TRANSMISSION: 4 speed synchromesh (except 1st): 3.385 to 1 in 1st; 2.055 to 1 in 2d; 1.333 to 1 in 3d; 0.896 to 1 in 4th; 4.275 to 1 in reverse.

TEST DATA

GASOLINE MILEAGE (checked with fuel volume flow meter and 5th wheel. Temperature 66°F; relative humidity 62%; barometer 29.6 in. Hg.)

LEVEL ROAD FUEL CONSUMPTION (carried weight 395 lb. Average of two or more runs made in opposite directions over same road):

True MPH	20	30	40	50	60
True MPG	53.8	52.3	48.5	39.8	28.4
True Ton MPG	46.3	45.0	41.7	34.2	24.4

TRAFFIC FUEL CONSUMPTION (carried weight 420 lb): Simulated traffic pattern of city driving—stops, acceleration, braking, at speeds primarily of 30 and 45 mph:

True MPG	True Ton MPG	True Average MPG
33.0	28.8	24.8

CITY-COUNTRY FUEL CONSUMPTION (miles covered on 5 gal. gas on course combining open road (country) and slower traffic (city) driving, at speeds of 30, 40, 50 and 60 mph):

True Mileage	True MPG	True Average MPH
203.9	41.3	33.9

OVERALL FUEL AND OIL consumed during test, including idling, warmups and all-weather driving:

Total Mileage	Total Gal Fuel	Total Oil	True MPG	Oil MPG
770	21.6	none	35.6	...

OVERALL EFFICIENCY to move car's mass against road friction and air resistance, calculated from level road mph, weight, and frontal area of car: 12.6% at 30 mph; 14.7% at 60 mph.

ACCELERATION—LEVEL ROAD (timed with 5th wheel; carried weight 390 lb; Temperature 55°F; relative humidity 67%; barometer 29.5 in. Hg; average of two or more runs in opposite directions over same road):

MPH (True)	0-20	0-30	0-40	0-50	20-40
Time (sec)	4.74	9.24	16.6	26.7	11.7

GEAR SHIFT PATTERN: Standing start to 20 mph in 1st, 20 to 35 in 2d, 35 to speed in 3d. 20-40 test run from steady 20 mph in 2d to 35, 35 to 40 in 3d.

QUARTER MILE SPRINT from standstill: 49.8 mph (true) in 26.3 sec.

MINIMUM ACCELERATION time for 0-50 mph (true) over level road with no wind, best spark setting, and driver alone: 21.5 seconds.

ACCELERATION FACTORS:

True MPH	Gear	MPH/sec.	Ft./sec. ²
10	1st	4.3	6.4
20	2nd	3.1	4.5
30	2nd	1.6	2.4
40	3rd	1.3	1.8
50	3rd	0.66	0.94
60	4th	0.19	0.28

HILL CLIMBING AND DRAWBAR PULL (calculated from acceleration data with allowances made for rotational inertia):

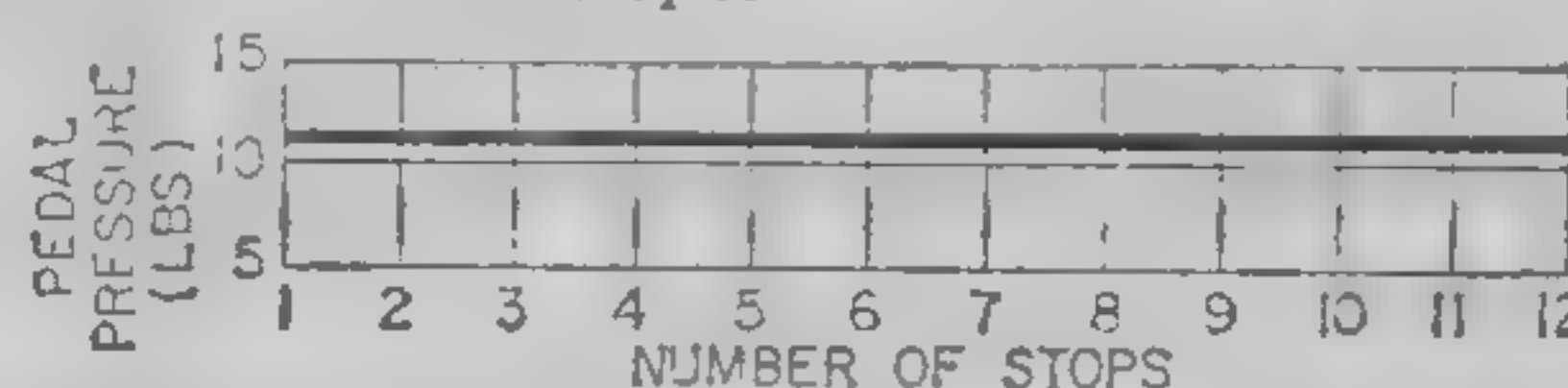
Approx. MPH	Gear	Grade %	Pull in lb.
60	4th	0.84	14.4
30	3rd	8.25	141

SPEEDOMETER-ODOMETER CORRECTIONS: Odometer distance, 10.0 miles; true distance, 10.33 miles. For 10,000 true miles traveled, odometer will register 9680 miles. Odometer error at 45 mph was 0.33 miles. Multiplication factor and % of error 1.033 and -3.3%.

Speedometer MPH	True MPH	Engine RPM	Speedometer MPH	True MPH	Engine RPM
10	9.7	825	50	48.4	3725
20	18.8	1525	60	57.4	4425
30	28.4	2225	68 Top Speed	64.0	4900
40	38.5	3000			

LATERAL SWAY TEST OF CORNERING ABILITY: At steady 40 mph on 285-ft. radius circle, side tilt angle recorded was 2.5°.

BRAKE FADE TESTS (repeated applications of brake from 45 mph to 30 mph at deceleration rate of 7 ft/sec²): As indicated below, pedal effort did not double in 12 test stops.



LONGITUDINAL DIP ON BRAKING: At a steady deceleration rate of 21 ft/sec², body nose diving angle was 1.5°.

PARKING BRAKE TEST: When brake was applied hard and suddenly from 20 mph true speed, car braking distance was 34 ft. Left and right wheels locked.

CHASSIS DYNAMOMETER HORSEPOWER (tests made by Clark Automotive Service, Chicago): Temperature 80°F; relative humidity 60%; barometer 29.3 in. Hg.

MPH True	Engine RPM	Horsepower
52	4000	9.4
38.5	3000	8.8
32	2500	7.7

HORSEPOWER AT REAR AXLE (values calculated from acceleration data with allowances made for efficiencies and rotational inertia):

MPH True	Engine RPM	Equiv. Engine Torque (lb. ft.)	Axle Horsepower
60	4600	18.8	16.5
45.3	3500	22.5	15.0
32	2500	23.9	11.4

Per cent of advertised engine horsepower delivered to rear wheels: 75%.

ESTIMATED ANNUAL GASOLINE COSTS: \$89.80 for 10,000 miles (using regular gas at 32¢ a gallon).

CALCULATED PERFORMANCE FACTORS

True MPH at speed of max. advertised horsepower	60
True MPH at speed of max. advertised torque	35
Engine rpm at 60 mph (also rev. per mile)**	4619
Average piston speed at 60 mph (also ft./mile)**	1694
** Lower values indicate less wear and stress on the engine	
Cu. ft. per minute of mixture at 60 mph (also cu. ft./mile)—a theoretical measure of fuel economy—low values desirable	51.6
Max. engine HP (adv) per ton of car (curb wt.)—a theoretical measure of acceleration performance—high values desirable	33.2
Max. engine HP (adv) per cu. in. displacement—a measure of design excellence in producing power—high values desirable	0.57
Power performance factor (a weighted average of CR, displacement and curb wt.). This is a theoretical measure of potential acceleration	47.0

CERTIFICATION

I certify that the test results in this report are the actual findings obtained in tests, conducted in accordance with good engineering practice, on the automobile named and under the conditions specified.

Edw J Chert

Member, Society of Automotive Engineers, American Society of Mechanical Engineers, Director, Automotive Research Laboratories, Professional Engineering Consultants.

ROADABILITY: Very little but some oversteer. Almost no braking stop. Brakes well. Moderate wind wander at 60 mph. Shift handling plays large part up for low power in traffic.

RIDING AND DRIVING

Entry to front seat is easy, low. Getting into rear takes effort and pivoting. Contoured front thin and low (11 inch) but give excellent back and support. Slow 5½ turns open front windows don't open. No arm trays. Doors open easily from inside hazard at high speed. Front-mounted latch and elbow. Rear engine noise small. VW. Slight gear noise at 40 mph.

INSTRUMENTS AND CONTROLS

Four-speed floor shift is positive travel. Reverse is to far right with knob depressed. Pedals call for heel-and-toe operation. Defroster ducts crowd pedals. Kicked now and then. Handbrake (rah) under dash, welcome. Choke and starter are levered. Dily on ventilating tunnel valve. brake. Vent hump is small.

Small speedometer dial numbered red lines for shift to determine speed by quick toggle for lights to right of but light selector lever is loose. signal: up for parking, center down for high. Warning amps and temperature in Heating is by air from engine lever on tunnel by rear seat. Air can be directed to door floor, behind rear seat or air

MISCELLANEOUS:

Leather makes spare tire easy to make (in front) unlocked by hand. Gas tank in front could stand sion-insulation. Engine hood side pull latch. Jack is egg in easily-found hole, lifts engine off ground. Quality of finish upholstery excellent. Does not anywhere, and door needs a close when windows are up. for ignition and driver's side mirror has small light on map-reading but bad for

tions from 45 to 30 mph pedal force of only 11 p

Fiat also sports good tracks, and a long deer hill to her. Like any some large chuck hole bomb craters, but if you can spot the holes coming tance, over the center 15 feet, 6 inches—fully 2 beetle-nosed VW. (Real

Not much storage space cap; (B) gage sender and (D) strapped-in spare tire rolled back and battery cylinder filler; (H) windshield hold-open catch, mu

CORRECTIONS: Odometer distance, 10.33 miles. For odometer will register 9680 45 mph was 0.33 miles. of error 1.033 and -3.3%.

Speedometer MPH	True MPH	Engine RPM
50	48.4	3725
60	57.4	4425
68 Top Speed	64.0	4900

CORNERING ABILITY: At radius circle, side tilt angle

ed applications of brake at deceleration rate of 7 low, pedal effort did not

7	8	9	10	11	12
OF STOPS					

ING: At a steady deceleration nose diving angle was

brake was applied hard true speed, car braking right wheels locked.

ORSEPOWER (tests made e, Chicago): Temperature barometer 29.3 in. Hg.

Horsepower
9.4
8.8
7.7

(values calculated from vances made for efficien-

Engine Torque (lb. ft.)	Axle Horsepower
18.8	16.5
22.5	15.0
23.9	11.4

horsepower delivered to

INE COSTS: \$89.80 for gas at 32¢ a gallon).

PERFORMANCE FACTORS

and horsepower	60
and torque	35
er mile)**	4619
o ft/mile)**	1694

and stress on the engine 0 mph (also cu. ft./el economy—low val-

(curb wt.)—a theo-ormance—high values

lacement—a measure power—high values

0.57

average of CR, dis-theoretical measure

47.0

CONCLUSION

in this report are the ts, conducted in ac-ong practice, on the e conditions specified.

Chert

Engineers, American Director, Automotive al Engineering Con-

Driver's Observations

ROADABILITY: Very little sway or lean, but some oversteer. Almost no dip on panic braking stop. Brakes well on wet surface. Moderate wind wander at 60 mph. Good shift handling plays large part in making up for low power in traffic.

RIDING AND DRIVING COMFORT:

Entry to front seat is easy, except seat is low. Getting into rear takes some bending and pivoting. Contoured bucket seats in front thin and low (11 inches from floor) but give excellent back and thigh support.

Slow 5½ turns open front windows; rear windows don't open. No arm rests or ash trays. Doors open easily from front (possible hazard at high speed) by pulling front-mounted latch and pushing with elbow. Rear engine noise seems less than VW. Slight gear noise at any speed.

INSTRUMENTS AND CONTROLS:

Four-speed floor shift is positive, with short travel. Reverse is to far right and back, with knob depressed. Pedals close together, call for heel-and-toe operation. Unsightly defroster ducts crowd pedal area and get kicked now and then. Hand throttle (hurray) under dash, welcome on cold days. Choke and starter are levers located handily on ventilating tunnel with emergency brake. Vent hump is small.

Small speedometer dial cluttered with numbered red lines for shift points; hard to determine speed by quick glance. On-off toggle for lights to right of center cluster, but light selector lever is located with turn signal: up for parking, center for low and down for high. Warning lamps for oil, amps and temperature in center cluster. Heating is by air from engine radiator; lever on tunnel by rear seat opens duct. Air can be directed to defrosters, front floor, behind rear seat or any combination.

MISCELLANEOUS: Leather buckle strap makes spare tire easy to remove. Trunk (in front) unlocked by handle under dash. Gas tank in front could stand more collision-insulation. Engine hood opens by outside pull latch. Jack is eggbeater type, fits in easily-found hole, lifts entire side of car off ground. Quality of finish, fittings and upholstery excellent. Doesn't leak a drop anywhere, and door needs a healthy slam to close when windows are up. Separate keys for ignition and driver's side door. Inside mirror has small light on back, good for map-reading but bad for inside lighting.

tions from 45 to 30 mph at an unwavering brake pedal force of only 11 pounds.

Fiat also sports good stability crossing railroad tracks, and a long deep hollow is just a small hill to her. Like any short car, she reacts to some large chuck holes as though they were bomb craters, but if you stay on the ball you can spot the holes coming. Fiat's eye-to-road distance, over the center of the hood, is a short 15 feet, 6 inches—fully 2 feet, 3 inches better than beetle-nosed VW. (Rearward vision is adequate,

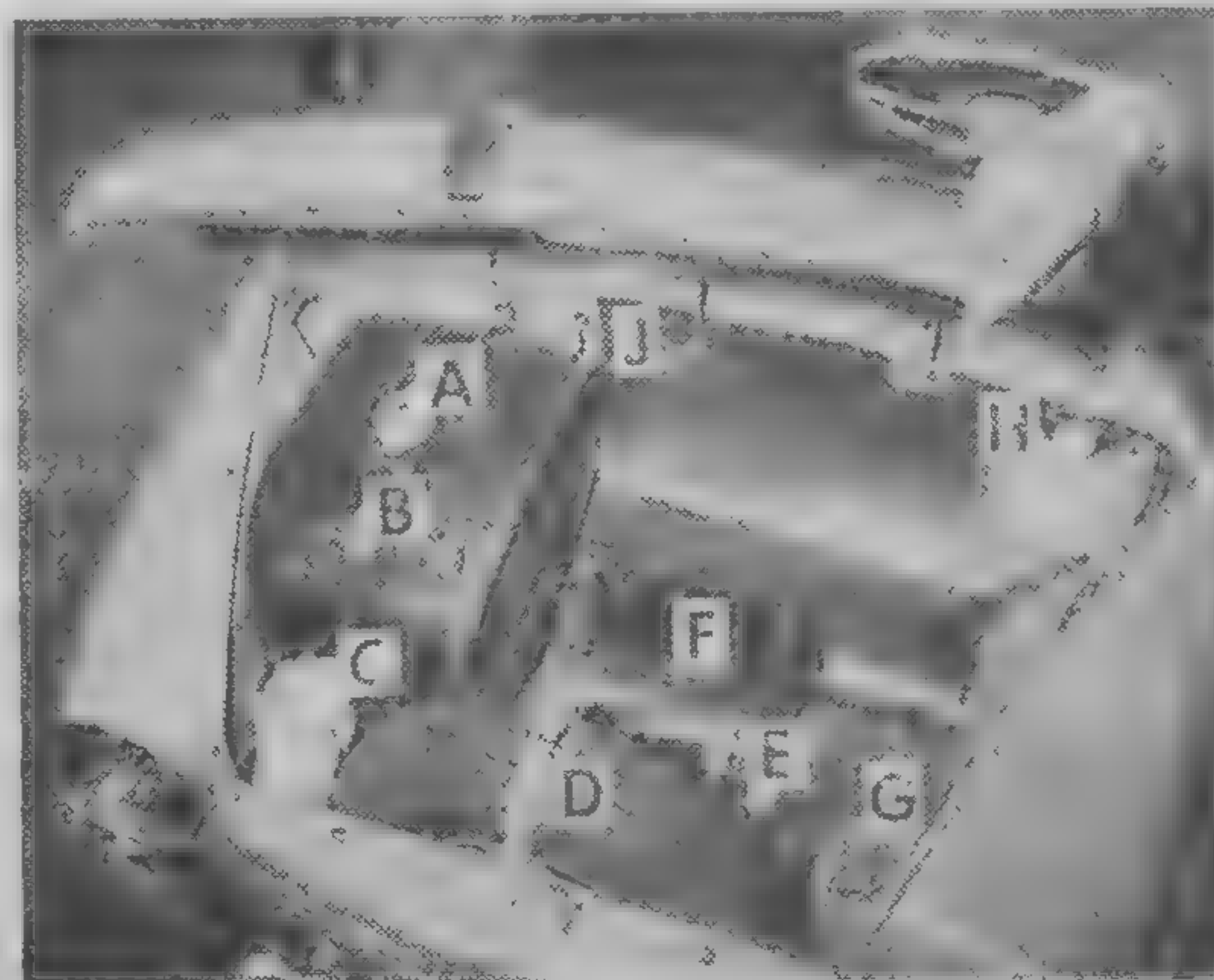
Not much storage space up front. (A) is gas tank filler cap; (B) gage sender and overflow spill; (C) tool kit; (D) strapped-in spare tire; (E) battery well; (F) mat rolled back and battery cover lifted; (G) brake master cylinder filler; (H) windshield wiper bag, and (I) hood hold-open catch, must be released by hand.



Inside the Fiat 600. (A) is door pocket; (B) emergency brake; (C) choke; (D) starter; (E) shift lever; (F) heat outlet; (G) defroster ducts; (H) hand throttle; (I) hood release; (J) wind-shield washer switch; (K) on-off light switch, and (M) padded knee guards.



Here is Fiat's 4-cylinder, overhead valve, water-cooled rear engine. Note (A) exhaust pipe; (B) fuel pump; (C) distributor; (D) air cleaner; (E) oil filter; (F) carburetor; (G) generator; (H) water pump; (I) fan; (J) radiator; (K) voltage regulator; and (M) coil.



Front, Rear, Water or Air? Fiat is covering all the bases in this fuss about front versus rear engine and air- versus water-cooling. Their 500 series (smaller than our test car) has an air-cooled rear engine; the 600 has a water-cooled rear engine; the larger models have water-cooled front engines and they are all fine machines. It's not what you do, it's how you do it.

Efficient Heating. The 600's cooling system is somewhat unusual for a water-cooled engine. Air enters through louvers in the rear hood, passes through the fan, then through the radiator and out through a shutter under the car. Most water-cooled engines use a thermostat which throttles the flow of water to get quick warmup and maintain operating temperatures under low loads. The Fiat keeps water flowing at maximum rate, but a thermostat in the radiator (hence in the water) controls the air outlet shutter and reduces the flow of air at part loads. The hot air heater bleeds air from the outlet duct under fan pressure. By restricting the air flow rather than the flow of water to the radiator, Fiat engineers insure a supply

of hot air for the passengers, even with cold weather and light loads.

We're not completely happy, though, with a heater which uses air from the engine compartment. If the exhaust connections are tight, it's safe; but loose connections can mean that deadly carbon monoxide is pumped into the passenger compartment. Fiat minimizes the danger by putting the muffler outside the engine compartment, but we suggest that Fiat owners keep the windows cracked open and not park for long when using the heater.

Why Heat the Engine? The reasons for keeping an engine warm are just as good as those for keeping it from overheating. Cold manifolds mean poor fuel vaporization and consequent high fuel consumption and cylinder wear. A cold block means condensation of fuel vapor on the cylinder wall; and wall and ring wear results, due to poor lubrication. Water, a product of combustion, leaks past the rings and condenses in the oil sump. Oil temperature must be high enough to evaporate water and gasoline from the sump, so that its lubricating qualities won't be reduced.

though, only if the inside mirror is supplemented with one outside.)

No Unmixed Blessing. Fiat's brochures show a pretty young lady putting a few small packages in the 600's trunk. They fill it.

Useable trunk volume is only about 1.4 cubic feet, little more than a glove compartment (which it doesn't have, though roomy door pockets make up for this lack).

There is additional storage space behind the rear seat—44 x 7 x 13 inches. And the rear seat folds down—at no extra cost—so two passengers can have a space 13 inches high running back from the front seat for suitcases or groceries.

Space troubles carry over into the passenger picture. Bucket seats in the front and shoulder room of only 43.2 inches in the rear guarantee that this is a 4-passenger car, no more. And if those two in back are 6-footers, they had better take off their hats and slouch down.

The Fiat 600 is priced at \$1398 at port-of-entry,



Ultra-efficient wipers cover a lot of windshield. Blades don't return automatically to rest when turned off. Third position on toggle switch returns them. Note tiny rear vision mirror.

plus taxes, transportation and dealer delivery and handling charges. But to make an honest price comparison with other cars in Fiat's class, look at the extras you get as standard equipment—whitewalls, undercoating, windshield washer, folding rear seat and those life-guarding finned aluminum brake drums.—WAYNE WILLE.

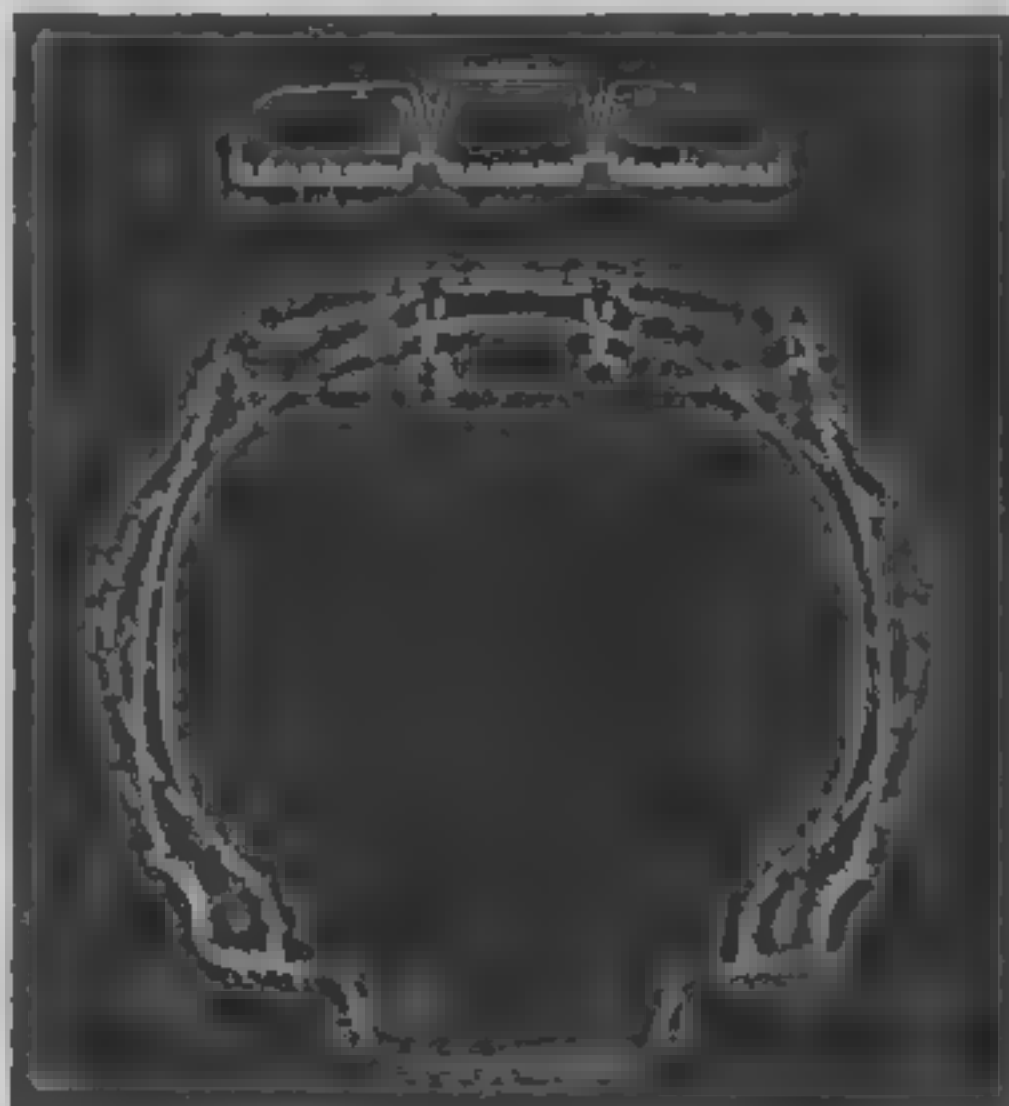
Startling New Tire Has Replaceable Treads



Diameter of the tread bands is less than that of the casing. When bands are placed around casing and tire is inflated, air pressure locks them in position. Casing also has radial ridges to insure perfect seating for the bands and to prevent lateral movement.

WHEN this tire wears out, you replace only the tread—or just a part of the tread—not the whole tire.

The radically new type of automobile tire con-



Solid lines show outline of uninflated casing without tread bands. Dotted lines indicate inflated casing with treads in position. Treads are reinforced on inner surface with bands of flexible inextensible metal cords.

sists of a casing and three separate tread bands, which can be mounted or dismounted without tools.

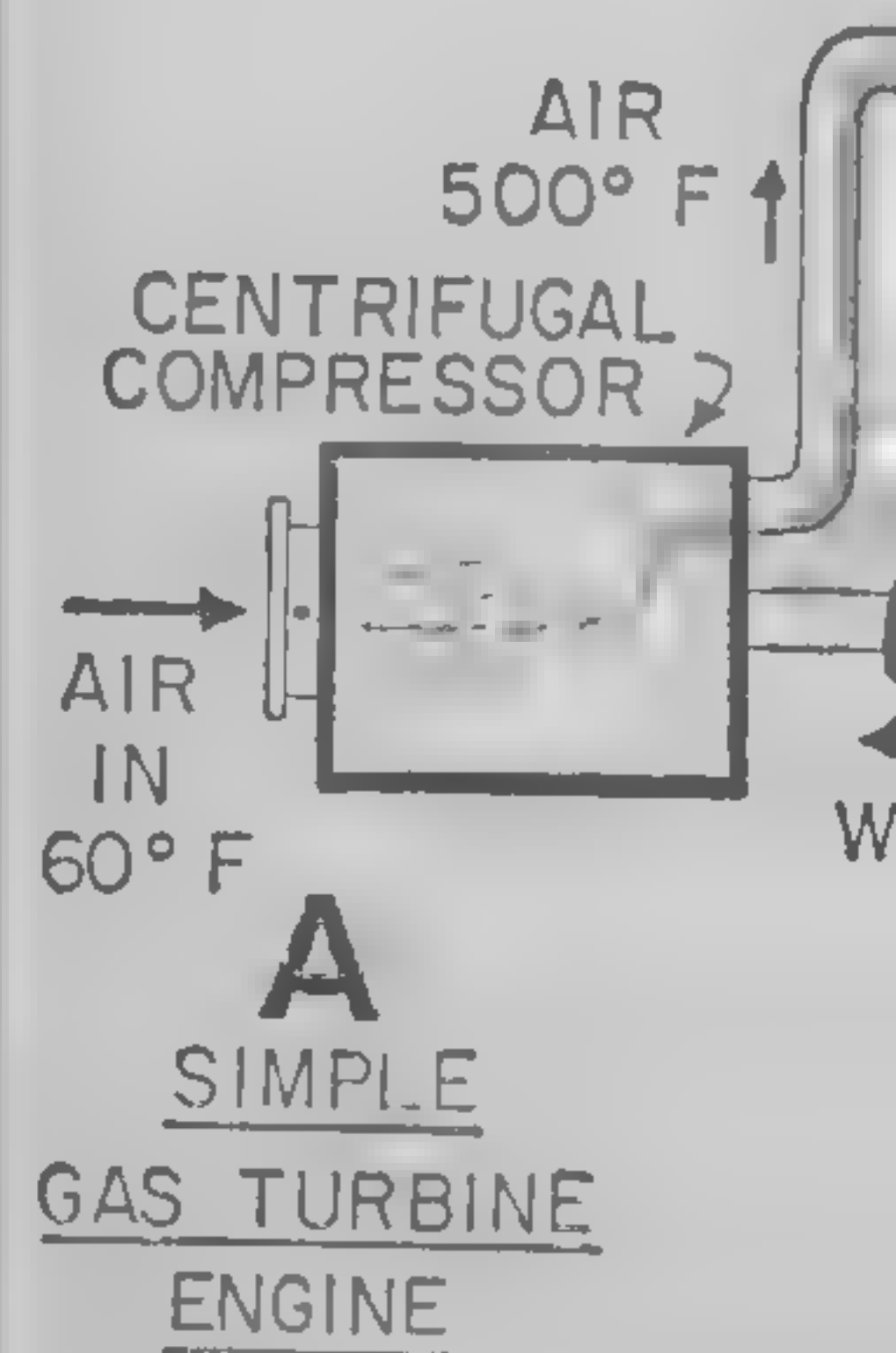
For winter use, you can put on a tread pattern suited for ice and snow. Tungsten steel spikes also can be fitted to the tire, between the tread bands.

The tire is made by the Pirelli Co., Milan, Italy, and will soon be sold in the United States.



Chrysler's experimental engine is lowered into 1 test car. On one 576-mi. erage speed of 38.3 mph 19.4 mpg. Inset shows c instrument panel. Dial speedometer. At top r compressor section rpm's in center shows turbine i perature, and fuel and c at bottom.

HEADLINE news ab minium engines h that Detroit's Big all the stops to develop a put pistons out of busin One forecast is that y large trucks and buses v in your car in perhaps Why a turbine engine engineers like the idea • Tremendous power relatively small package

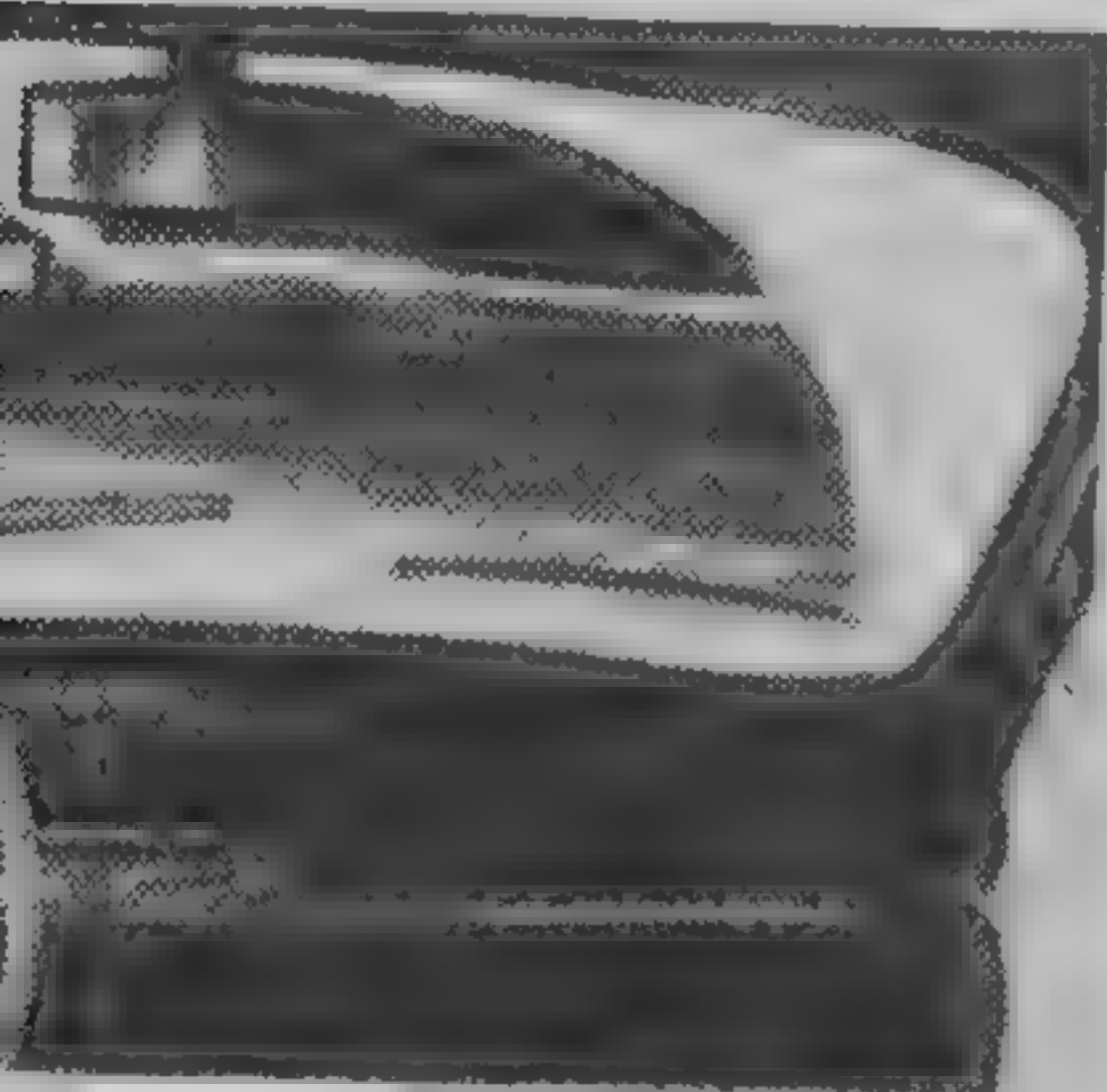


Simple gas turbine engine Efficiency is low and hot exchanger—to th

gers, even with cold weather

appy, though, with a heater
engine compartment. If the
ght, it's safe; but loose con-
deadly carbon monoxide is
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we suggest that Fiat owners
open and not park for long

e? The reasons for keeping
s good as those for keeping
manifolds mean poor fuel
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l block means condensation
der wall; and wall and ring
lubrication. Water, a prod-
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rature must be high enough
asoline from the sump, so
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a lot of windshield. Blades
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—WAYNE WILLE.

e Treads

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Tungsten steel spikes
tire, between the tread

Pirelli Co., Milan, Italy,
the United States.

Will Gas Turbines Replace Piston Engines?



Chrysler's experimental gas turbine engine is lowered into 1959 Plymouth test car. On one 576-mile run at average speed of 38.3 mph, it averaged 19.4 mpg. Inset shows car's modified instrument panel. Dial at top left is speedometer. At top right, turbine compressor section rpm's. Wide gage in center shows turbine inlet gas temperature, and fuel and oil gages are at bottom.



HEADLINE news about rear engines and aluminum engines has almost buried the fact that Detroit's Big Three have pulled out all the stops to develop a gas turbine which might put pistons out of business.

One forecast is that you'll see gas turbines in large trucks and buses within the next five years, in your car in perhaps 10.

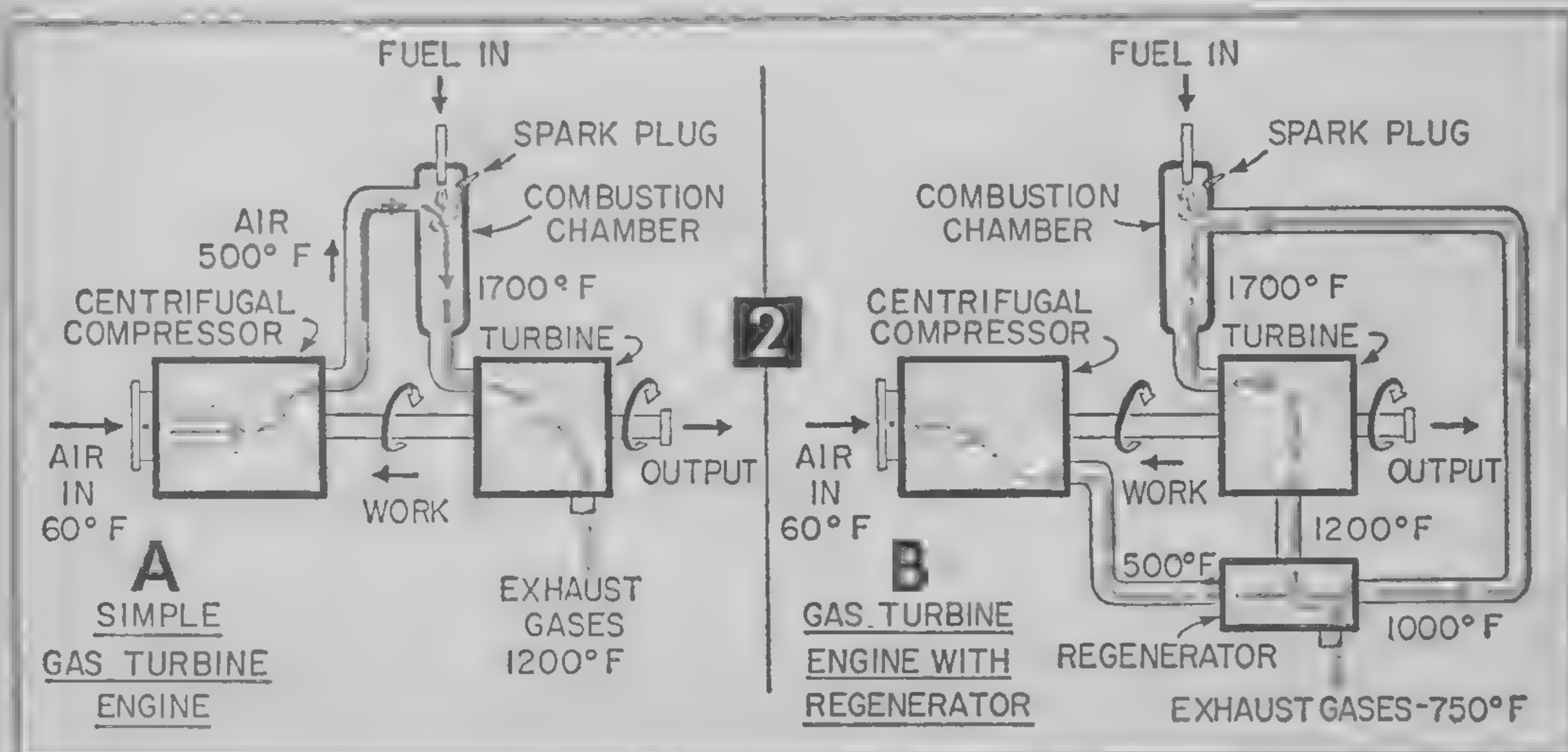
Why a turbine engine for cars? Automotive engineers like the idea because:

- Tremendous power can be designed in a relatively small package. Ford's 704 gas turbine

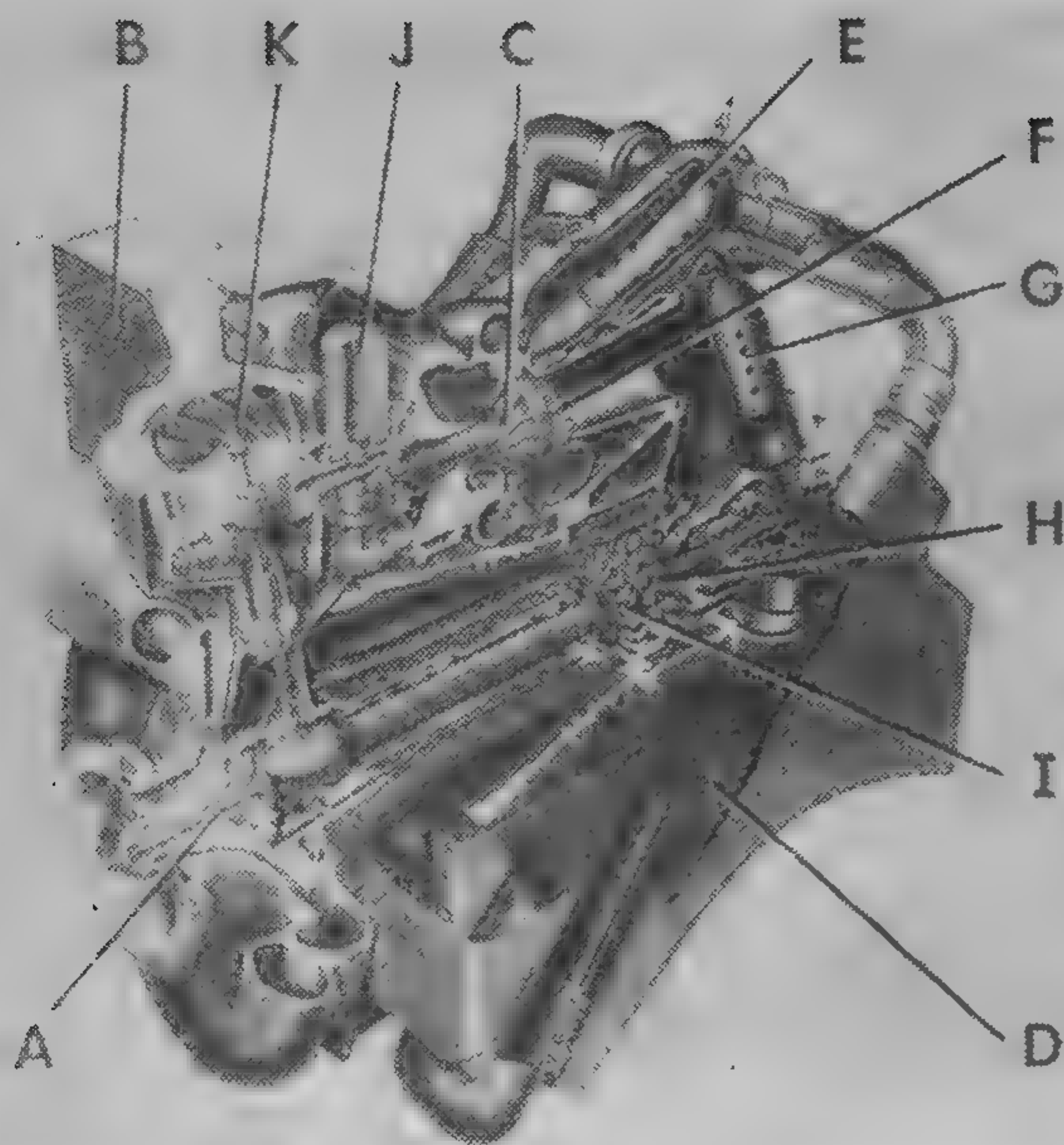
currently under testing and development turns out 300 hp, weighs 650 pounds without transmission and is roughly comparable in size to a V-8 truck engine.

- Fuel can be kerosene, which means lower cost and less fire hazard.
- There are no severe lubrication problems.
- It is smooth running because of the absence of rod-and-crank reciprocating motion.

There are some drawbacks to the gas turbine, notably its possibly higher cost and lower-than-piston-engine efficiency. There is also a noise



Simple gas turbine engine (A) has only three basic components: compressor, combustion chamber and turbine. Efficiency is low and hot exhaust gases are at 1200°F. Regenerative engine (B) adds a regenerator—heat exchanger—to the cycle, increasing efficiency and lowering exhaust temperature to 750°F.



Cutaway shows main components of Ford's 704 gas turbine engine: (A) First stage compressor; (B) Intercooler—half on each side of engine; (C) Second stage compressor; (D) Regenerator—half on each side; (E) Primary combustion chamber; (F) High speed turbine; (G) Secondary combustion chamber; (H) Power turbine; (I) Low speed turbine; (J) Fan for intercooler, and (K) Governor.

problem. Because of its high-rpm turbines, the engine has a high-pitch roar, much like a jet engine. And, large-scale buying of American compact cars and their smaller European brethren could doom the gas turbine, since low-power turbines will undoubtedly remain inferior to the small piston engines for many years.

Still, the state of the gas turbine art has been progressing so rapidly that Detroit is becoming more and more confident about that in-your-car-by-1970 prediction.

How Turbines Work. A simple gas turbine engine is shown in Fig. 2A. Air enters a centrifugal compressor (driven by the turbine) where its pressure and temperature is increased. It then passes into the combustion chamber, where fuel is burned to raise the temperature still higher.

Combustion increases the volume of the gases, so that when they pass through the turbine, making it rotate, more work is obtained than is needed to drive the compressor. Hence, work is available for useful power. How much work depends on the amount of heat added between the compressor and the turbine.

The turbine engine has one drawback in that it must use relatively low compression ratios. The piston engine can use a highly-efficient compression ratio of 10 to 1, since the resulting combustion temperature of about 5000°F is experienced only momentarily and intermittently, thus won't damage the metal.

But the gas turbine—a steady-flow machine—can use maximum temperatures of about only 1800°F, else the metal will burn because of the

continuous high temperature. This means the turbine must use low compression ratios, else the temperature after compression will be too high to allow any further increase by burning fuel (and it is from the fuel that excess energy is obtained).

Still, the engine of Fig. 2A would perform acceptably if it could be operated at only its design speed and power. But at half-speed, only about a fourth or a third of the maximum power would be needed. And here its efficiency would be especially bad, since part-load is obtained by reducing combustion temperature, which thereby reduces the expansion ratio and cuts efficiency.

Boosting Turbine Efficiency. A number of techniques can be used to increase the gas turbine's efficiency. In Fig. 2B, the hot, used gases from the turbine are funneled into a regenerator, where they heat the compressed air before combustion. Thus, less fuel need be burned to attain combustion temperature.

Another technique is to cool the air before or while it is being compressed, since the work needed to

compress air depends on its temperature—less work being needed to compress cold air than hot.

Ford's 704 (see Fig. 3), while not as simple as the engines in Figs. 2A and 2B, is much more efficient. It has two compressors, so the air can be cooled between the two stages—thus saving work. It has three turbines, so that only the one connected to the transmission need be run at variable speed, while the others run at optimum speed. The 704's cycle is as follows:

Air enters the first-stage compressor at—let's say—100°F, and undergoes a 4 to 1 increase in pressure and an increase in temperature to about 450°F.

The air then goes through an intercooler, where its temperature is reduced to about 220°F before it enters the second-stage compressor, where another 4 to 1 increase in pressure is obtained, and a temperature of about 625°F.

The air then passes into a regenerator and undergoes another 375°F temperature rise, sending it into the combustion chamber at roughly 1000°F. Fuel is added and the mixture burns, reaching 1700°F.

This gas drives the high-speed turbine (91,500 rpm) that powers the second-stage compressor. The exhaust gas from this turbine is reheated to 1700°F in another combustion chamber before it goes to the takeoff-power turbine (36,000 rpm), then on to a double-stage, constant-speed turbine (46,500 rpm) that drives the first-stage compressor. Finally, the exhaust gases move to a regenerator, where they release heat to the incoming air after the second compression stage. They are then rejected into the atmosphere at about 740°F.

Ford says the 704 has 100 horsepower hour at full power, .58 at half power, .58 at quarter power. The GT-305 Whirlfire in the Titan II truck is also a gas turbine. It has been designed to consume 100 horsepower hour. GM predicts less than .4 pound per horsepower hour in the future.

The \$? Question. The improvements means the makers to ask themselves



Largest P

THROW in enough water and this new and pour about a h ment a day.

The largest concrete duces some 40% more now in use.

It gets its name, the partment drum, which

Tr

THE fuel cell finally out of the laboratory vehicle for the first experimental tractor in houses a small army under its hood—1008 ranged in four banks, 7 convert bottled gases, pane, into electricity (S '59, S&M).

The resulting direct through a controller, v the driver to regulate verse direction. Using trol, the driver can pl banks of cells in serie thus varying the amou going to the 20-hp mot ers the tractor. To changes the polarity of The fuel cells used we by Allis-Chalmers Mfg. kee, Wis.

is high temperature. The turbine must use low compression ratios, else the temperature will be too high to further increase by burning, and it is from the fuel that energy is obtained).

The engine of Fig. 2A would be acceptably efficient if it could be at only its design speed and output at half-speed, only about one-third of the maximum. Efficiency would be especially bad at low load is obtained by reducing combustion temperature, which reduces the expansion ratio and efficiency.

Improving Turbine Efficiency. A number of techniques can be used to improve the gas turbine's efficiency. In Fig. 2B, the hot, used gases from the turbine are funneled into a preheater, where they heat the incoming air before combustion. This reduces the fuel need to attain the same combustion temperature.

Another technique is to cool the turbine while it is being compressed. Since the work needed to compress cold air is less than hot air (Fig. 3), while not as simple as Fig. 2A and 2B, is much more efficient. Two compressors, so the air can be compressed in two stages—thus saving space and weight, so that only the one compressor need be run at optimum speed while the others run at optimum efficiency, is as follows:

First stage compressor at—let's say 4 to 1 increase in pressure and temperature to about 400°F. Then through an intercooler, where the temperature is cooled to about 220°F before the second stage compressor, where an even higher pressure is obtained, and the temperature rises to 625°F.

Then into a regenerator and undergo a temperature rise, sending the combustion chamber at roughly 1000°F. The fuel mixture burns, reaching

the high-speed turbine (91,500 rpm) and a second-stage compressor. This turbine is reheated to the combustion chamber before it enters the power turbine (36,000 rpm), a constant-speed turbine which drives the first-stage compressor. The hot gases move to a regenerator to preheat the incoming compression stage. They are then exhausted to the atmosphere at about 740°F.

Ford says the 704 burns .56 pound of fuel per horsepower hour at full load (and .48 pound at half power, .58 at quarter-power). The 225-hp GT-305 Whirlfire in GM's experimental Turbo-Titan II truck is also a regenerative type and has been designed to consume .55 pound per horsepower hour. GM predicts fuel consumption of less than .4 pound per horsepower hour is in the future.

The \$? Question. The prospect of such improvements means that it's time for the auto makers to ask themselves a big question: "Is this

the engine for us?"

It is a tough decision for Detroit. The answer depends greatly on future improvements in compact engine design and on reducing production costs—since a lot of machining is needed to turn out the hundreds of blades used for each turbine, and expensive alloys are required to withstand the high temperatures.

There is little doubt, however, that gas turbine engines will show up in a few years in such vehicles as heavy-duty tractors and bulldozers, half-tracks and off-road vehicles of all types.



Largest Paver Pours and Pours and Pours

THROW in enough aggregate, cement and water and this new monstrous paver will mix and pour about a half mile of two-lane pavement a day.

The largest concrete paver ever built, it produces some 40% more concrete than machines now in use.

It gets its name, the *Tribatch*, from a 3-compartment drum, which mixes three batches at

once. While material for one batch is being loaded into the first compartment, concrete is mixing in the second and being discharged from the third. Thus, two batches—about 75 cubic feet of concrete—are produced every minute.

Powered by a 180-hp General Motors diesel engine, it is 74 feet long and weighs 70,000 pounds. It's made by Koehring Company, Milwaukee, Wis.

Tractor Runs on Fuel Cell Power

THE fuel cell finally has moved out of the laboratory to power a vehicle for the first time. The experimental tractor in the picture houses a small army of the cells under its hood—1008 of them, arranged in four banks. They instantly convert bottled gases, mainly propane, into electricity (see p. 107, Apr. '59, S&M).

The resulting direct current flows through a controller, which permits the driver to regulate speed or reverse direction. Using the speed control, the driver can place the four banks of cells in series or parallel, thus varying the amount of current going to the 20-hp motor that powers the tractor. To reverse, he changes the polarity of current flow. The fuel cells used were developed by Allis-Chalmers Mfg. Co., Milwaukee, Wis.



Tractor, with hood removed, shows fuel cells packed in front of driver. Each cell is 1/4-inch thick and 12 inches square. Total electrical output is 15 kw and tractive power is 3000 pounds at drawbar on a dynamometer. The tractor is a standard Allis-Chalmers D-12, modified for fuel cell use.

A DETECTIVE, armed with criminology's newest weapon—a do-it-yourself portrait kit—questions a holdup victim.

"Notice anything unusual about the gunman's eyes?" asks the detective.

"They were oval shaped," the victim recalls.

Quickly, the detective takes from his kit a coded 5 by 7-inch sheet of clear plastic, imprinted with a pair of unmistakably oval eyes. Carefully he places the transparency—coded E-56 (the E for "eyes"—atop another etched with the gunman's square-chinned facial contour (C-40).

"And his nose?" asks the detective.

"It was long—long and thinner than most."

The officer nods and riffles through his kit's more than 500 facial "pieces," fully 50 of them noses—every size and shape of nose possible.

Feature by coded-feature, the gunman's portrait builds. Chin, nose, eyes, lips. Even telltale scars, mars and blemishes. Picture complete, the detective displays his handiwork.

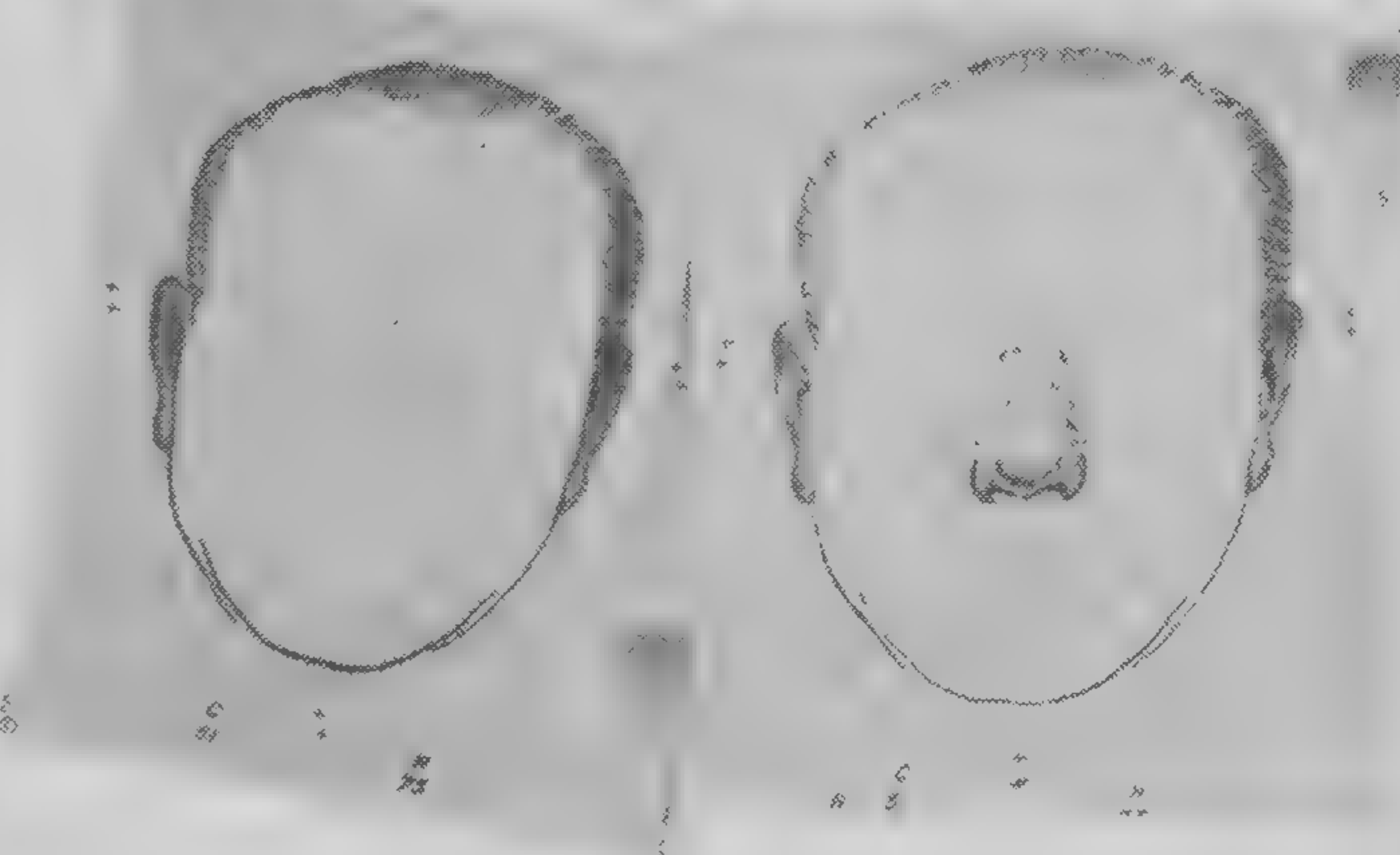
"That's him," gasps the startled victim. "That's the fellow who robbed me!"

Pieced together at the scene of the crime, the suspect's full-face likeness is flashed within seconds to prowling cars:

"Pick up suspect with N-35 nose, E-56 eyes, L-45 lips. . . ."

In the cars, equipped with picture kits, other policemen quickly fit the coded pieces together and have a lifelike "mug shot" of the wanted man to aid their search.

Face Building—Crime Fig



To build a face with new Identi-Kit, start with a hairline and a chin. Then . . .

. . . add a nose and . . .



. . . eyes. Face is completed when . . .

Meantime, in the police Identification Bureau, electronic sorters are sifting files—spewing out the arrest record of every previous offender with the same coded description.

Result? Some of the most spectacular police work since the birth of fingerprinting.

In Los Angeles, top detectives are routinely equipped with the picture kits. And, in 18 cases cracked during a recent four-month period, 16 of the in-the-flesh suspects matched to a tee their composite portraits.

Typical was a manhunt for a daring gunman who'd robbed seven stores. But not one of the victims could fully recall his face. One, however, graphically described the man's nose. Another

recalled the shape of his eyes. A third, the peculiar arch of his eyebrows. The composite—piece-mealed from the victims—was instantly recognized by them all.

Hours later a cruise car arrested a man for a minor offense. The officer was struck by the suspect's

Detective questions a witness to a crime to get a description of the criminal which he will match with "pieces" from Identi-Kit. Learning questioning and put-together technique requires about 40 hours of instruction.

height, well over 6 feet. been described as unusual pulled out his composite—standing in front of him.

Behind so remarkable a story, much of it still se by more than a decade of its \$87,000 development co portedly underwritten arm of U. S. intelligence device—called *Identi-Kit* within 20 minutes recrea likeness of any man on ear

"In all, there are 62,000,0 possible combinations in th "says Chief Hugh C. McD veteran identification ex with the Los Angeles C Sheriff's Department. " ever the face, we can con with a true-to-life like witnesses can describe the

Chief McDonald invente kit, but its compilation req the efforts of scores of rese ers on five continents.

"We began with a photog of what you might call typical American male says. "An artist traced h photo—12 identifying comp ing the contour of his fac and nose. Then the work

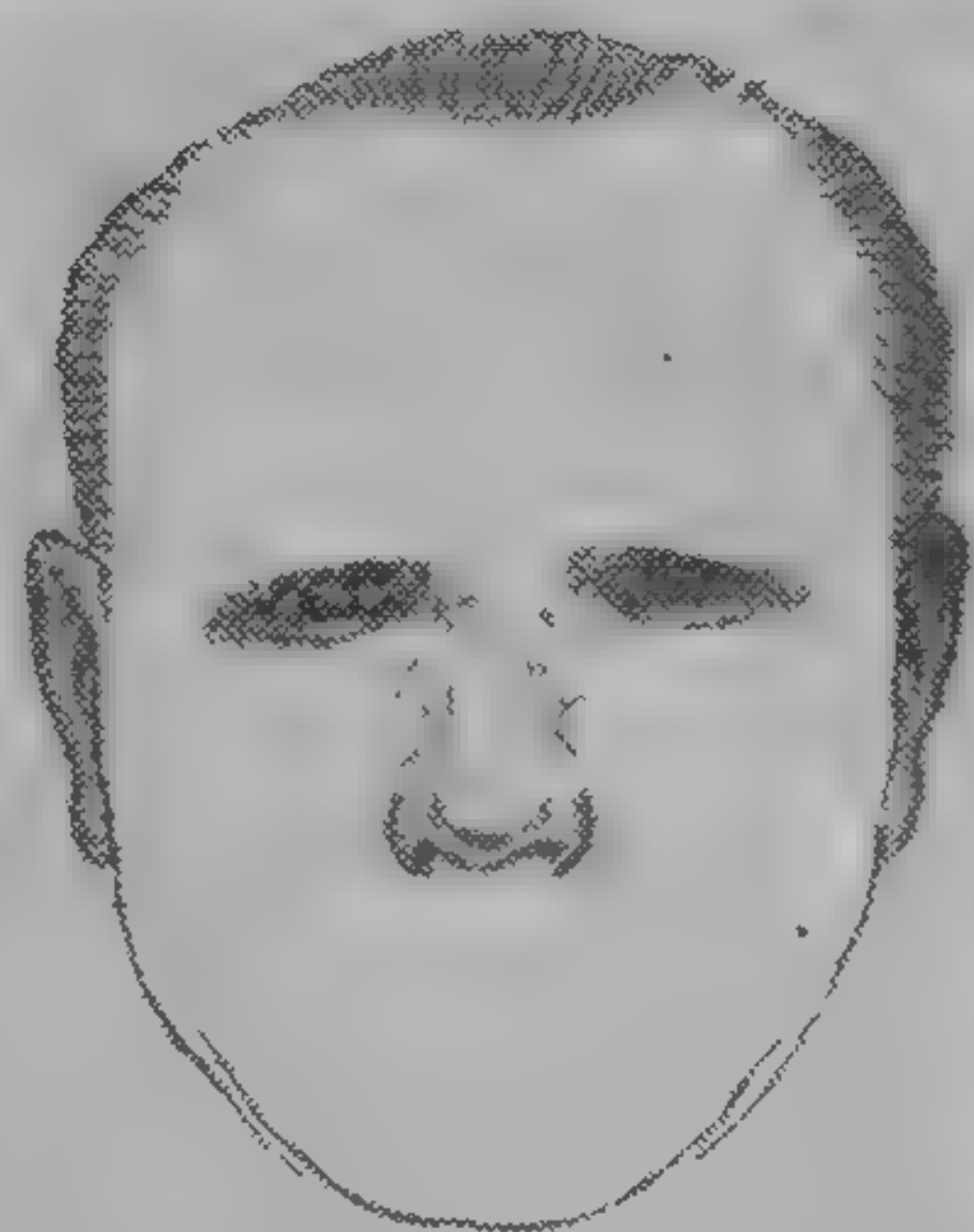
Photographers the world sands of pictures: full-fac borers, African tribesmen, World-wide crime photo fil every distinctive feature a



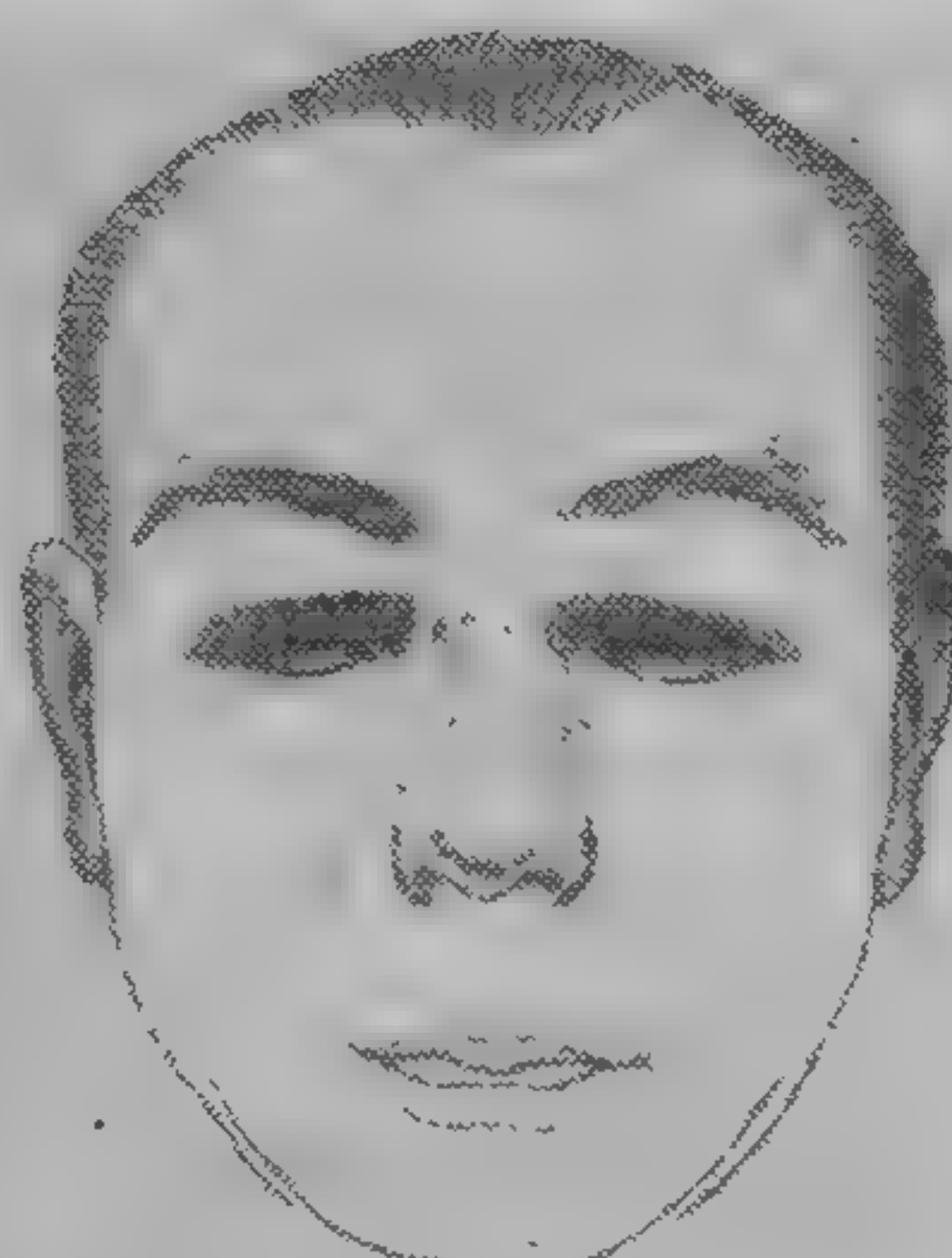
Building—Crime Fighting's New Tool



... add a nose and ...



... eyes. Face is completed when ...



... eyebrows and lips are added. Experts from photographic film companies aided in developing a special plastic so clear that light passes through easily—even when a dozen overlays are stacked.

the Identification Bureau, lifting files—spewing out previous offender with on.

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Detective questions a witness to a crime to get a description of the criminal which he will match with "pieces" from Identi-Kit. Learning questioning and put-together technique requires about 40 hours of instruction.

height, well over 6 feet. The armed robber had been described as unusually tall. The officer pulled out his composite—an image of the man standing in front of him.

Behind so remarkable a device is an exciting story, much of it still security-bound. Backed by more than a decade of world-wide research, its \$87,000 development cost reportedly underwritten by an arm of U. S. intelligence, the device—called *Identi-Kit*—can within 20 minutes recreate the likeness of any man on earth.

"In all, there are 62,000,000,000 possible combinations in the kit," says Chief Hugh C. McDonald, veteran identification expert with the Los Angeles County Sheriff's Department. "Whatever the face, we can come up with a true-to-life likeness, if witnesses can describe the man."

Chief McDonald invented the kit, but its compilation required the efforts of scores of researchers on five continents.

"We began with a photograph of what you might call 'the typical American male,'" he says. "An artist traced his features from the photo—12 identifying components in all, including the contour of his face, his eyebrows, eyes and nose. Then the work really began."

Photographers the world over snapped thousands of pictures: full-face shots of Indian laborers, African tribesmen, Japanese fishermen. World-wide crime photo files were searched, and every distinctive feature added to the growing

Among the others: "D" is for eyebrows, "F" for skin color (a flesh-colored sheet is slipped beneath the other overlays), "G" for glasses, "H" for hair, "T" for headgear, "L" for lips and "N" for noses.

Lastly, there's the scar grid—coded "S"—which permits an officer to grease-pencil the portrait with scars or other blemishes.

Notches—five of them cut into the edges of each plastic sheet—allow picture-makers to raise eyebrows, set noses lower on a face or close the gap between lip and chin.

"The device isn't intended as a replacement for standard police techniques," says Chief McDonald. "Rather, it is a completely new tool, designed to be used in conjunction with other methods."

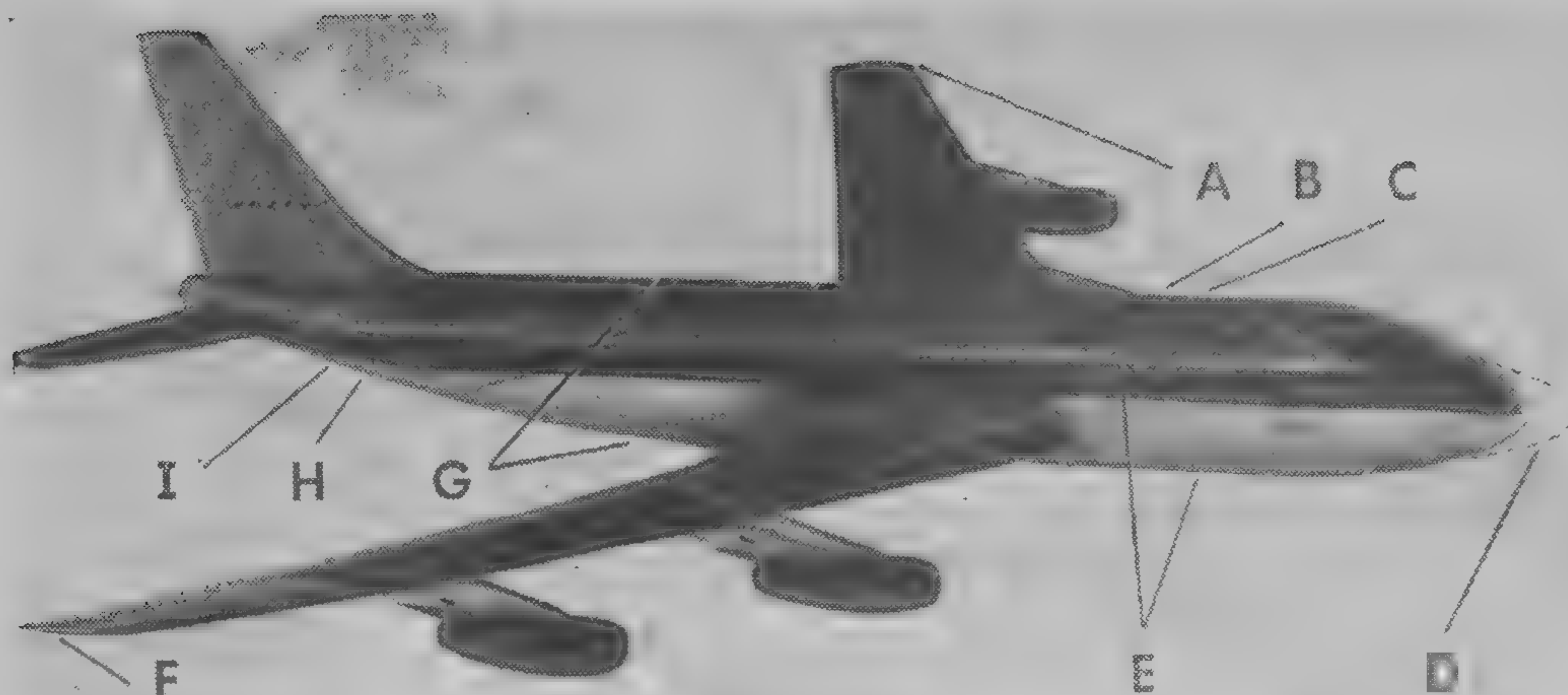
The kit is being tested by the FBI, Scotland Yard and Europe's famed Interpol, and it seems destined to revamp police techniques around the world. More than 7000 of the kits are expected to be in U. S. police service by 1961.

Ironically, the features of half the world's population—its women—are missing from the kit. Researchers are hard at work right now, however, compiling feminine features—from painted lips to plucked eyebrows. But this job is fraught with problems.

"Women," says one researcher, "do things to their features which nature never intended."—JAMES JOSEPH.



Chief Hugh C. McDonald, head of the Identification Bureau of the Los Angeles County Sheriff's Department, shown with his invention, the Identi-Kit.



Letters show location of weather gear: (A) Conductivity probe; (B) Turbulence probe; (C) Ozone, dewpoint, condensation nuclei probe; (D) Storm detection radar antenna; (E) Air sampling scoop and icing rate probes; (F) Fair weather probe; (G) Cloud base and top radar antenna; (H) Rocketsonde ejector, and (I) Dropsonde ejector. Wonder if the TV weather man will have to broadcast from the cockpit?

First Jetliner Weather-Lab Tested

TOMORROW'S weather forecaster might fly around in this Boeing 707 jetliner—a full-scale airborne weather laboratory recently flight-tested.

Crammed with electronic sensing and computing devices, the lab was designed to gather and analyze global weather data.

To give the plane a three-dimensional reach, launching tubes released instrumented containers—rocketsondes and dropsondes—to measure barometric pressure, temperature, ozone content, dew point and other data from sea level to 170,000 feet altitude.

The Mobot—Tomorrow's Sea Servant?

THE Loch Ness monster has nothing on this futuristic sea servant—a “Mobot” that works underwater.

It is just one of many adaptations that Hughes Aircraft Co., Culver City, Calif., forsee for future generations of its “race” of remote-controlled handling devices.

The first Mobot Mark I—a landlubber—is used in “hot” atomic research areas at Sandia Corporation, Albuquerque, N. M. Mobot's operator does not ride aboard, but sits in a safer area, where he directs the mobile robot's movements with pistol-like grip controls that form electronic “reins.” He views the hot areas through Mobot's closed-circuit television eyes.

New Astronomy Encyclopedia

WHAT do you want to know about astronomy and space? Chances are you'll find it in the just-published *Larousse Encyclopedia of Astronomy*.

The 506-page reference work is divided into four sections—“the Splendour of the Heavens,” “The Empire of the Sun,” “The Realm of the Stars” and “Astronomical Instruments and Techniques”—and contains a comprehensive index. It has 818 illustrations, including eight color plates.

Published by G. P. Putnam's Sons, 210 Madison Ave., New York City, the book sells for \$15.

Measure Radiation

How “hot” is the milk you drink? Here is a prize-winning science fair project you can build to find out

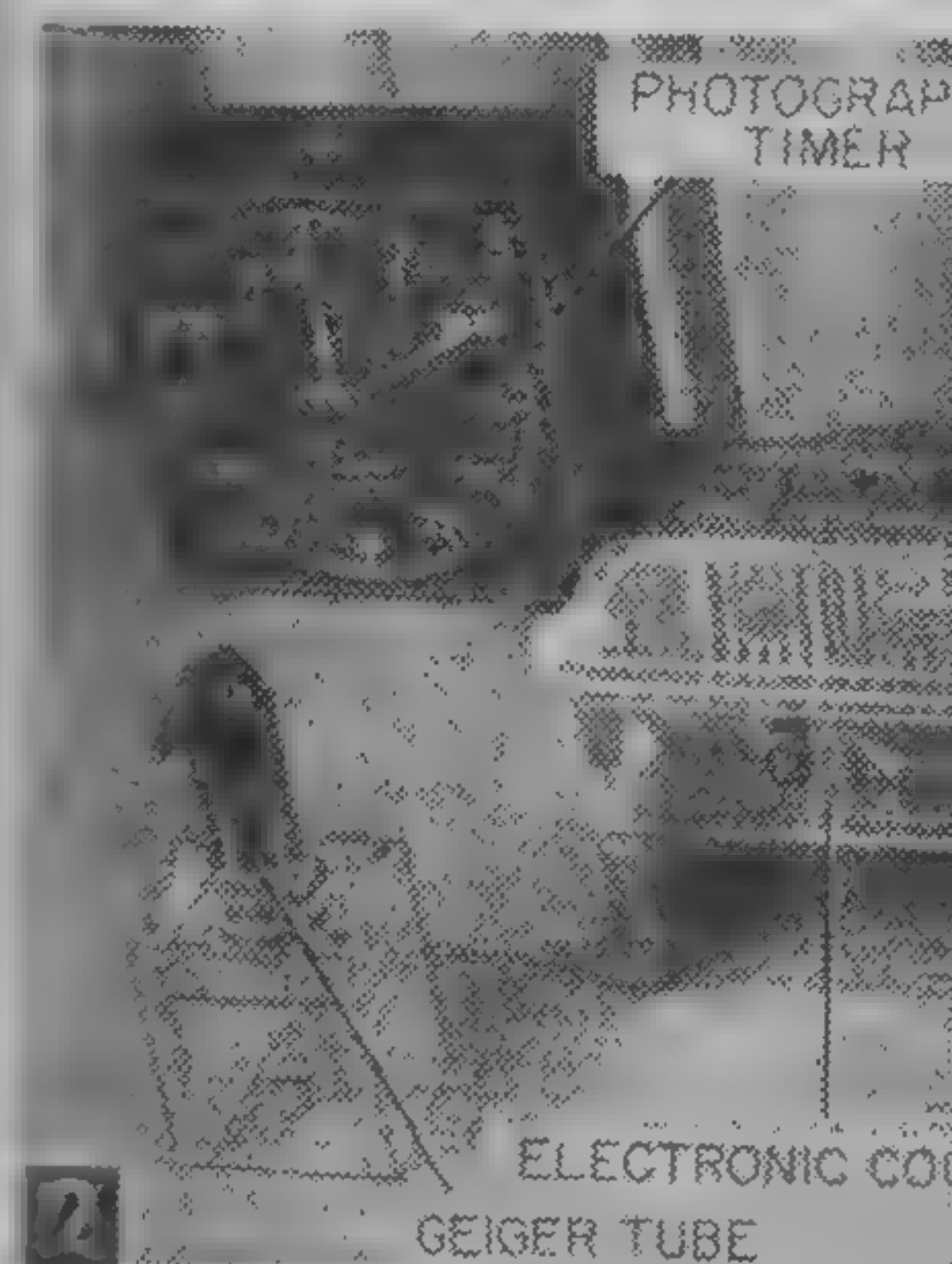
About the author:

Robert A. Schooley is a senior at Anacostia High School, Washington, D. C. This article is based on his 1959 Science Fair project, “Radioactivity in Washington, D. C., Milk,” which won first place in the Future Scientists of America Contest. Mr. Schooley plans to study electrical engineering at Iowa State University after his graduation from high school this year.

WITH the apparatus shown in Fig. 1, I measured the radioactivity in Washington, D. C., milk for 38 weeks.

My data fitted in with Public Health Service samples throughout the U. S. None, in Washington, which is what produced this project.

More and more emphasis is placed on such measurements because fallout ends up in our food.



This is complete counting apparatus since counter may be operated for

Artist's conception shows one possible version of Mobot, controlled by humans in the submarine, cutting pipe with acetylene torch while installing a pipeline on the bottom of the ocean. Another type of Mobot “swims” down carrying a section of pipe.

Measuring the Radiation in Milk

Everyday
SCIENCE

By ROBERT A. SCHOOLEY

How "hot" is the milk you drink? Here is a prize-winning science fair project you can build to find out

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Robert A. Schooley shown with equipment he built to measure radioactivity in milk from Washington, D. C., area. His findings fitted in with Public Health Service data from other U. S. cities.

WITH the apparatus shown in Fig. 1, I measured the radioactivity in Washington, D. C., milk for 38 weeks.

My data fitted in with that obtained at 12 Public Health Service sampling stations scattered throughout the U. S. None, however, is in Washington, which is what prompted me to choose this project.

More and more emphasis is being placed on such measurements because much radioactive fallout ends up in our food. An Atomic Energy

Commission spokesman predicts that 90% of the stratospheric debris—"hot" from nuclear bomb testing—will fall to Earth in the next 10 years, providing the test ban is continued.

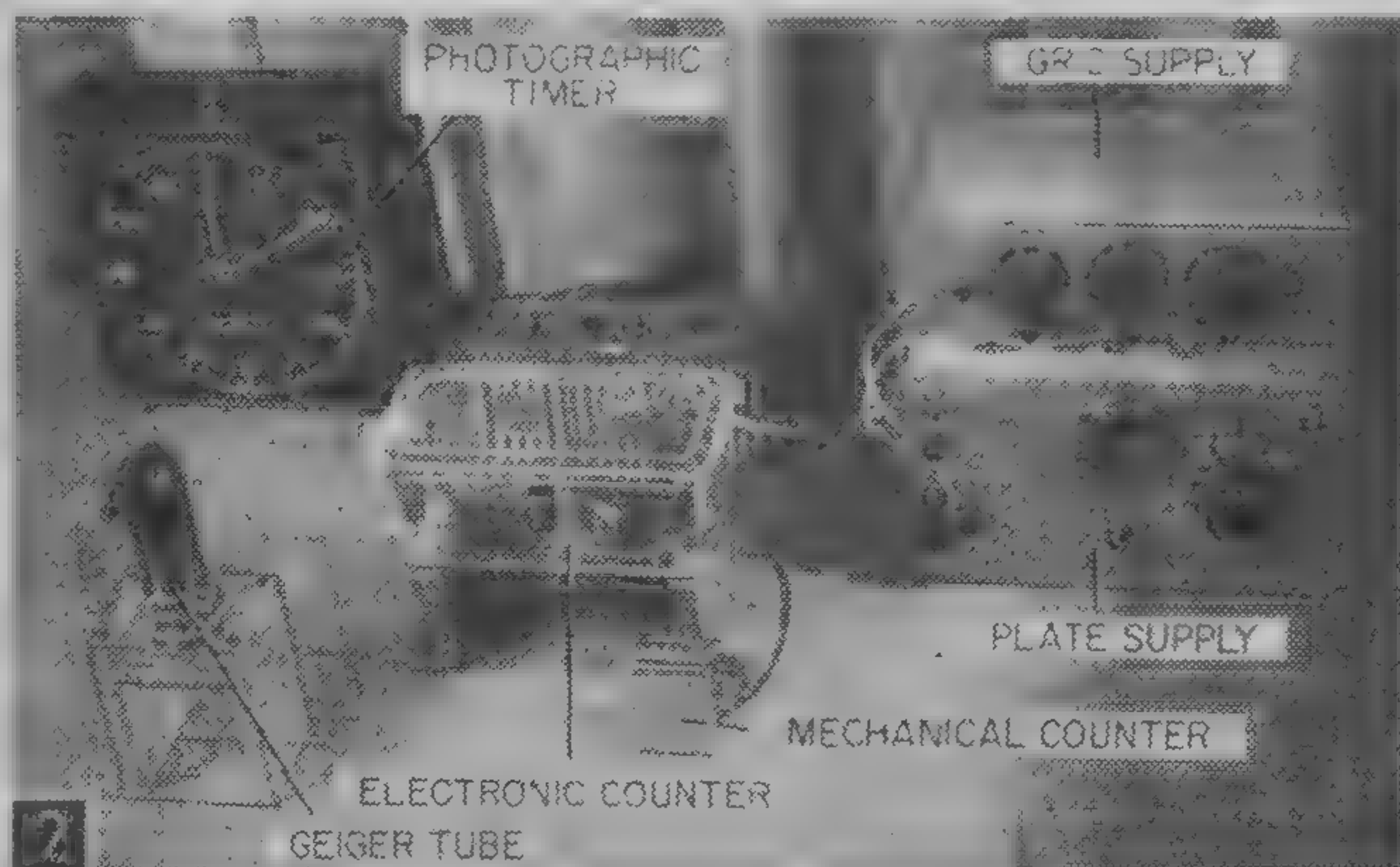
Government tests concentrate on milk, because it is the most practical sample and is produced all-year-long in all parts of the country.

By building and using a similar tester, you can determine the amount and fluctuation of radioactivity in your own town's milk.

Figure 2 shows the complete apparatus. The two components on the right are power supplies. The top one is the grid supply, encased in a cigar box. It supplies negative voltage to the grids of the tubes in the electronic counter, which is enclosed in a plastic refrigerator box.

The plate power supply can apply up to 400 volts d-c to the plate circuits of the electronic counter. In addition, it supplies 6.3 volts a-c to the tube filaments.

The electronic counter amplifies the narrow, low amplitude pulses from the Geiger tube and makes



This is complete counting apparatus. Photographic timer is optional, since counter may be operated manually, using wristwatch or clock for timing.

sted

three-dimensional reach, and instrumented containers sondes—to measure baro- ture, ozone content, dew from sea level to 170,000

rvant?

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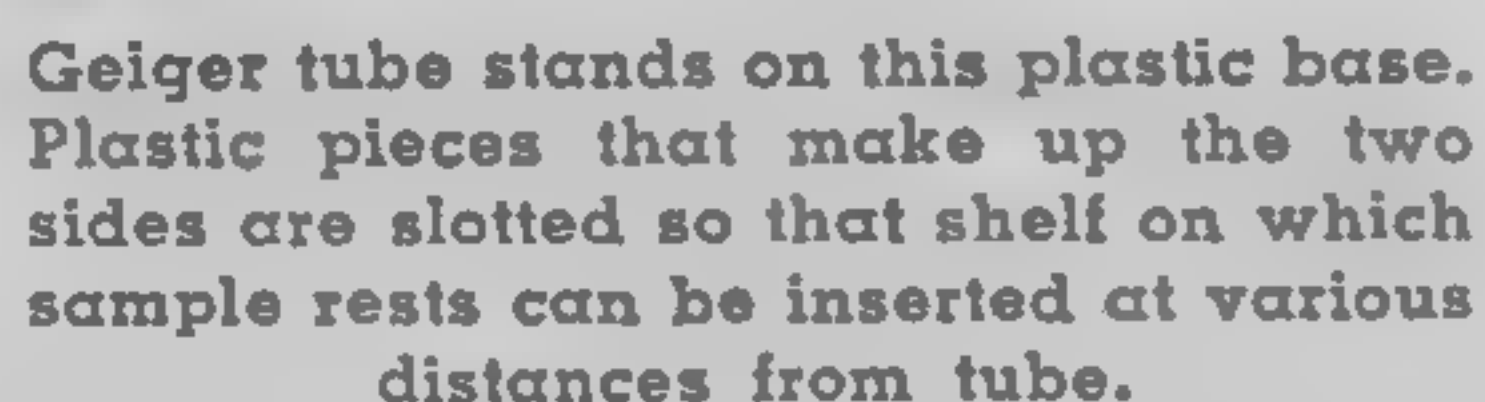
I—a landlubber—is used ch areas at Sandia Cor- N. M. Mobot's operator but sits in a safer area, mobile robot's movements trols that form electronic ot areas through Mobot's eyes.

stronomy
lopedia

to know about astronomy es are you'll find it in the *Encyclopedia of Astron-*

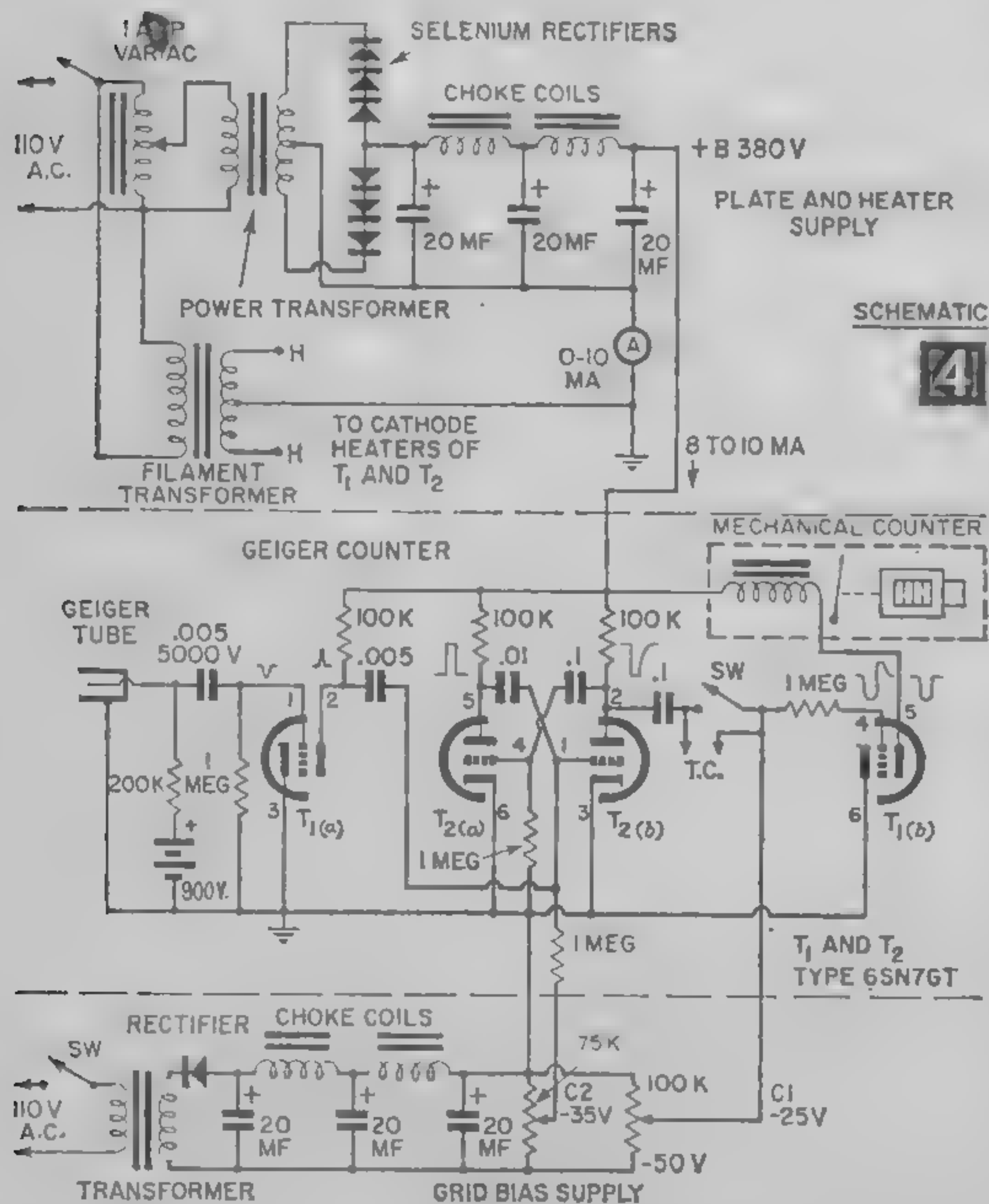
ce work is divided into endour of the Heavens," un," "The Realm of the al Instruments and Tech- comprehensive index. It luding eight color plates. tnam's Sons, 210 Madison ne book sells for \$15.

Triode T1(a) is normally conducting. When a current flows through the Geiger tube, there is a momentary voltage drop across the grid resist-



The plate power supply is the usual type of power supply—except that a variac has been con-

The first step is the removal of water and fat. This can be done in a pot of water. A piece of aluminum foil or in any container that will hold about a pint of milk can be used. The milk should be heated for four hours. This should be done in a pot, since the odor becomes very strong. After the four hours



ance of T1(a) resembling a negative pulse.

T1(a) amplifies this pulse and makes it positive in the plate circuit. This amplified positive pulse will now be able to actuate the one-shot multivibrator circuit of the double triode T2.

The purpose of the multivibrator is to further amplify the pulse and elongate it so it will last long enough to operate the mechanical counter. It consists of two triodes labeled T2(a) and T2(b), of which only one can conduct at a time. The grid of T2(b) has -35 volts applied to its grid so that it cannot conduct. Therefore, T2(a) will normally be conducting, except when a positive pulse from T1(a) is applied to the negative grid.

This pulse overcomes the and allows current to flow on only one side of the multivibrator at a time, side T2(a) where is normally a voltage of 100-ohm resistor to the plate. A negative pulse will be generated when T2(a) is conducting. A sudden drop across the 100,000-ohm plate of T2(b) when it starts to conduct a negative pulse.

A positive pulse thus generated goes to a buffer amplifier—T1(b). The tube, however, it passes through a short time constant differentiating circuit of the .1-mfd condenser, plate of T2(b) and about 10,000-ohm potentiometer in series (for the moment consider the potentiometer to be closed).

The circuit transforms the negative pulse applied to the plate of T2(b) so that it becomes positive.

Then, the positive part of the pulse is finally applied to the Geiger tube where it is registered.

The counter and its associated circuitry has a maximum of about six pulses per minute. This is because the circuit is very stable, and measurements are accurate.

Marked TC between T2(b) and T2(a) are for the photographic switch (SW) is also in the circuit. The counter may be operated by a ordinary clock or watch for timing.

Apply is the usual type of variac has been con-

nected to the primary coil of the power transformer to allow complete variation of the d-c output voltage.

The power supply uses dry metal rectifiers connected so there is full wave rectification. The filter, consisting of two choke coils and three electrolytic condensers, converts the pulsating d-c into smoothed d-c. A meter registers the output current in milliamperes. Also, there is a small transformer which supplies the 6.3 volts a-c to the filaments of the two tubes in the electronic counter.

The diagram for the grid supply is at the bottom of Fig. 4. There is one dry metal rectifier which changes the a-c to half-wave pulsating d-c. This is changed to smooth d-c by the filter, which consists of two choke coils and three electrolytic condensers. The potentiometers connected in parallel enable you to vary the output d-c voltage. Since it is necessary to have negative voltages in the grid circuits, the positive lead is common to both outputs.

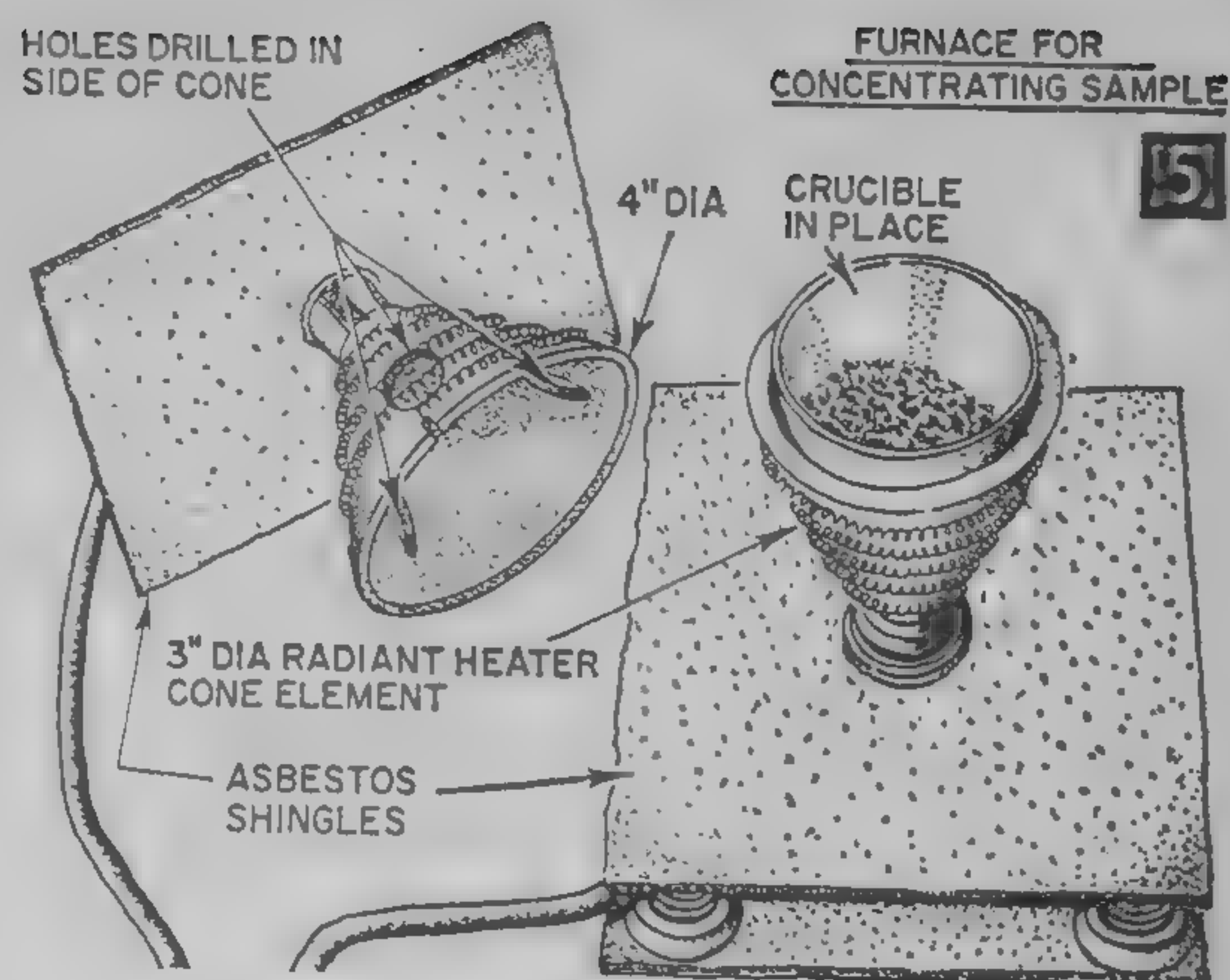
One other piece of apparatus must be built, the furnace for preparing the milk sample. The setup shown in Fig. 5 gives the high temperature needed. It consists of two 1000-watt cone elements of the type used in household radiant heaters. One has a 3-inch diameter, the other a 4-inch diameter which allows it to fit over the top of the smaller one.

Drill three holes in the side of the larger one so that during burning, air can circulate. The asbestos shingling above and below the cones protects the electrical cords from the intense heat.

Preparing the Sample. Since there is a very small amount of radioactive material in milk, it is necessary to concentrate the sample.

It is best to use skim milk, because the fat—which does not contain radioactive material—has been removed, saving you work.

The first step is the removal of water and other volatile material. This can be done in a popcorn popper lined with aluminum foil or in any other container where about a pint of milk can boil and char for about four hours. This should be done outside, if possible, since the odor becomes extremely penetrating. After the four hours, there will be a charred,

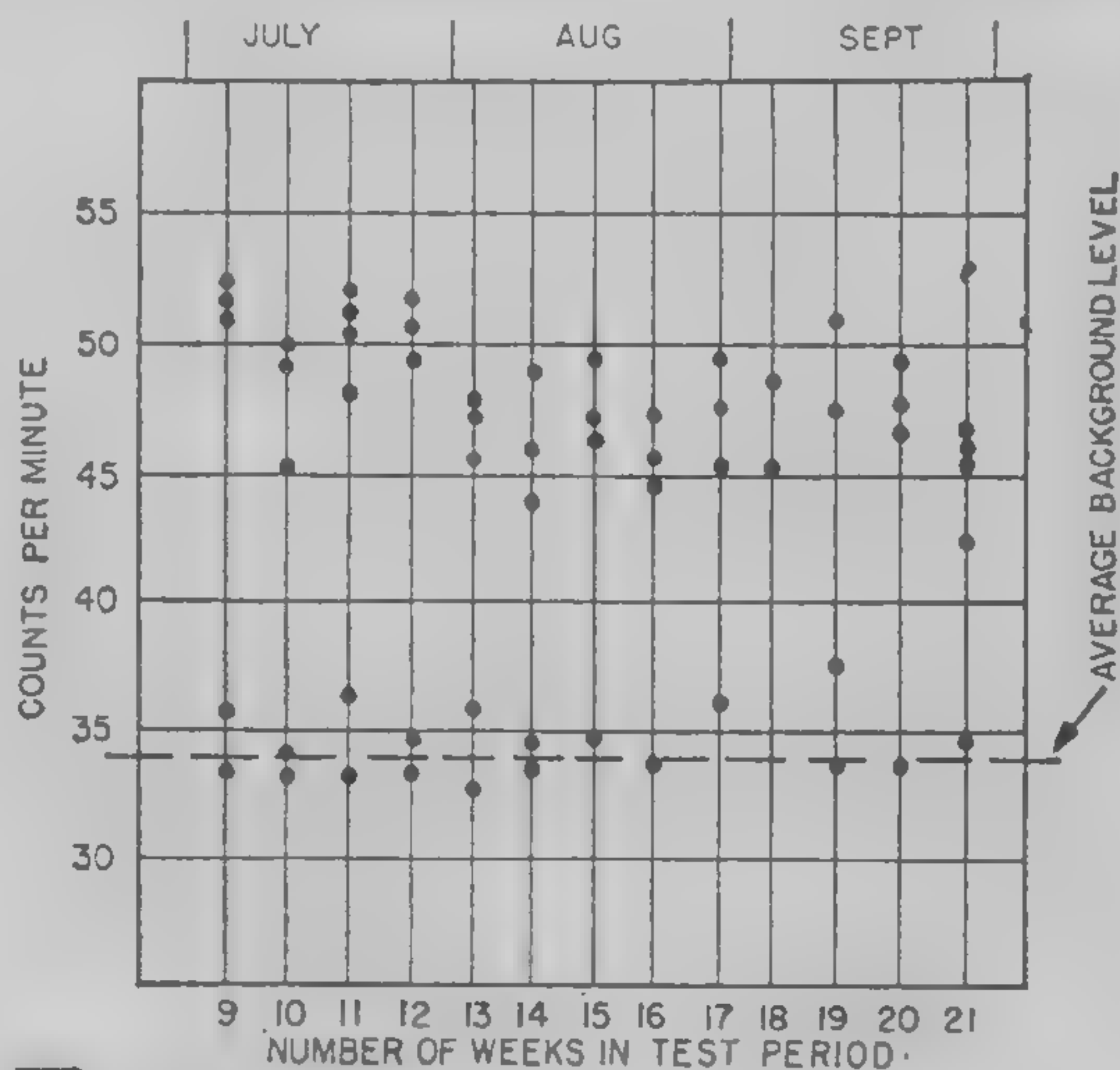


solid residue left along the sides and bottom of the foil.

Next, grind this charred material into a powder, using a mortar and pestle. Place the powder in a porcelain crucible, put the crucible inside the furnace as shown in Fig. 5, and turn on the electricity for about half an hour.

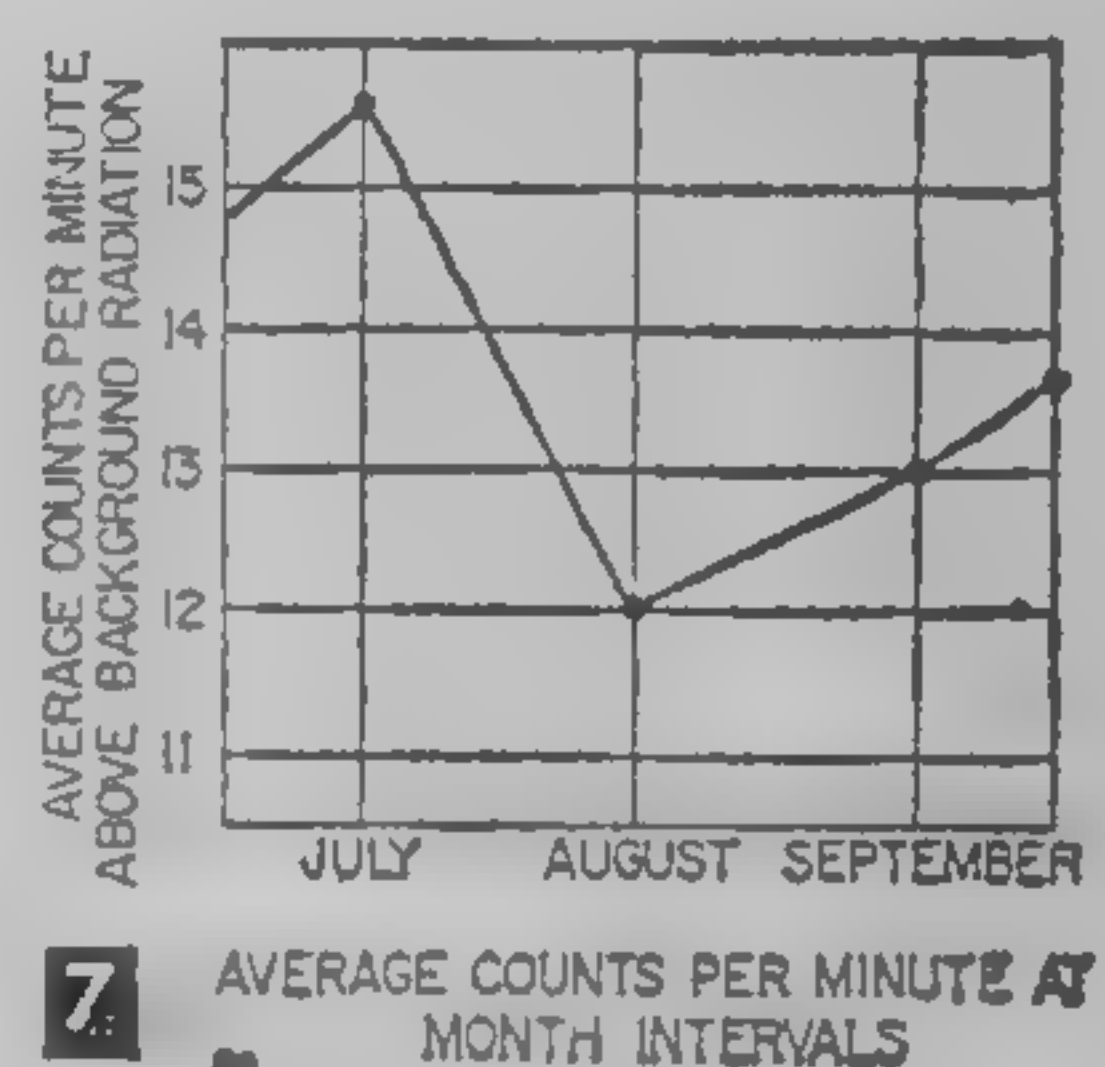
Now most of the carbon has been burned out. Grind the sample to a fine powder and weigh it to determine the percentage of concentration. I found that the weight of the milk I started with was 40 times the weight of the powder.

The final step is getting a uniform amount to



6 BASIC STATISTICAL DATA

Shown is a three-month section of 38-week chart. Horizontal dotted line is the average background level. Clusters of dots in the 45-55 count range indicate weekly readings of samples.



expose to the Geiger tube.

I found that new aluminum milk caps are excellent for holding the powder, since they have a flat lip that assures uniformity of filling. Put some of the powder in a cap and tamp it until it is packed as tightly as possible, then plane off the excess on top to obtain a smooth, level surface.

Make a mixture of 1 part of model airplane clear dope and 2 parts of dope thinner and apply some of it to the top of the sample with an eye dropper. When it hardens, it will seal the powder in the cap so that it can be handled and stored without spilling.

Taking the Data. Place a sample on the top shelf of the Geiger tube stand, making sure it

The two points plotted show counts-per-minute readings of the 20 and 100 micromicrocurie standards. Dots do not line up with plotted line because of slight inaccuracies in relatively inexpensive calibration equipment used. Inset shows enlargement of lower section. To convert counts per minute to micromicrocuries, read count up left-hand scale, then draw line to slanting line and read down to horizontal scale. Thus, 10 counts per minute converts to 6 micromicrocuries.

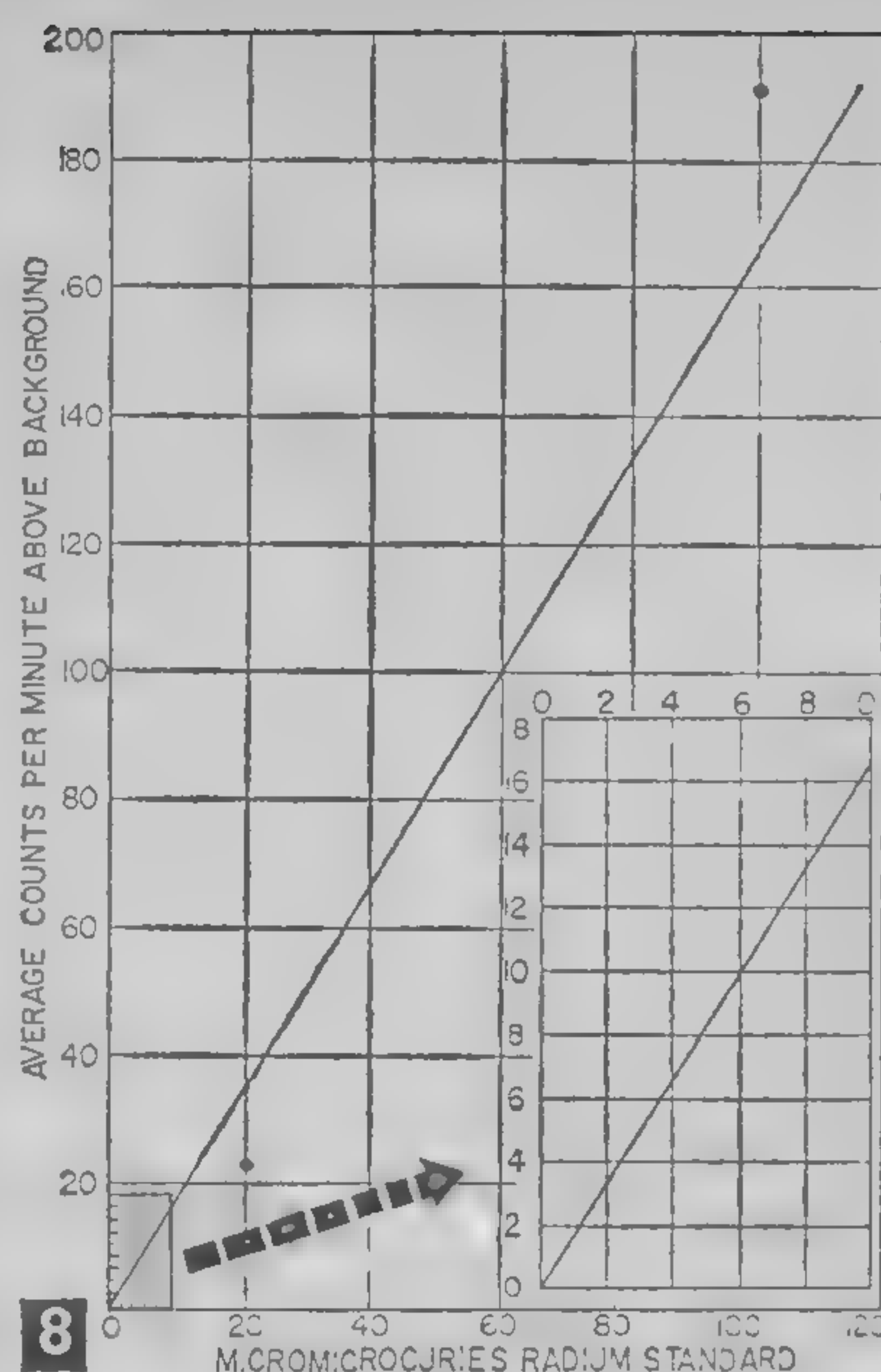
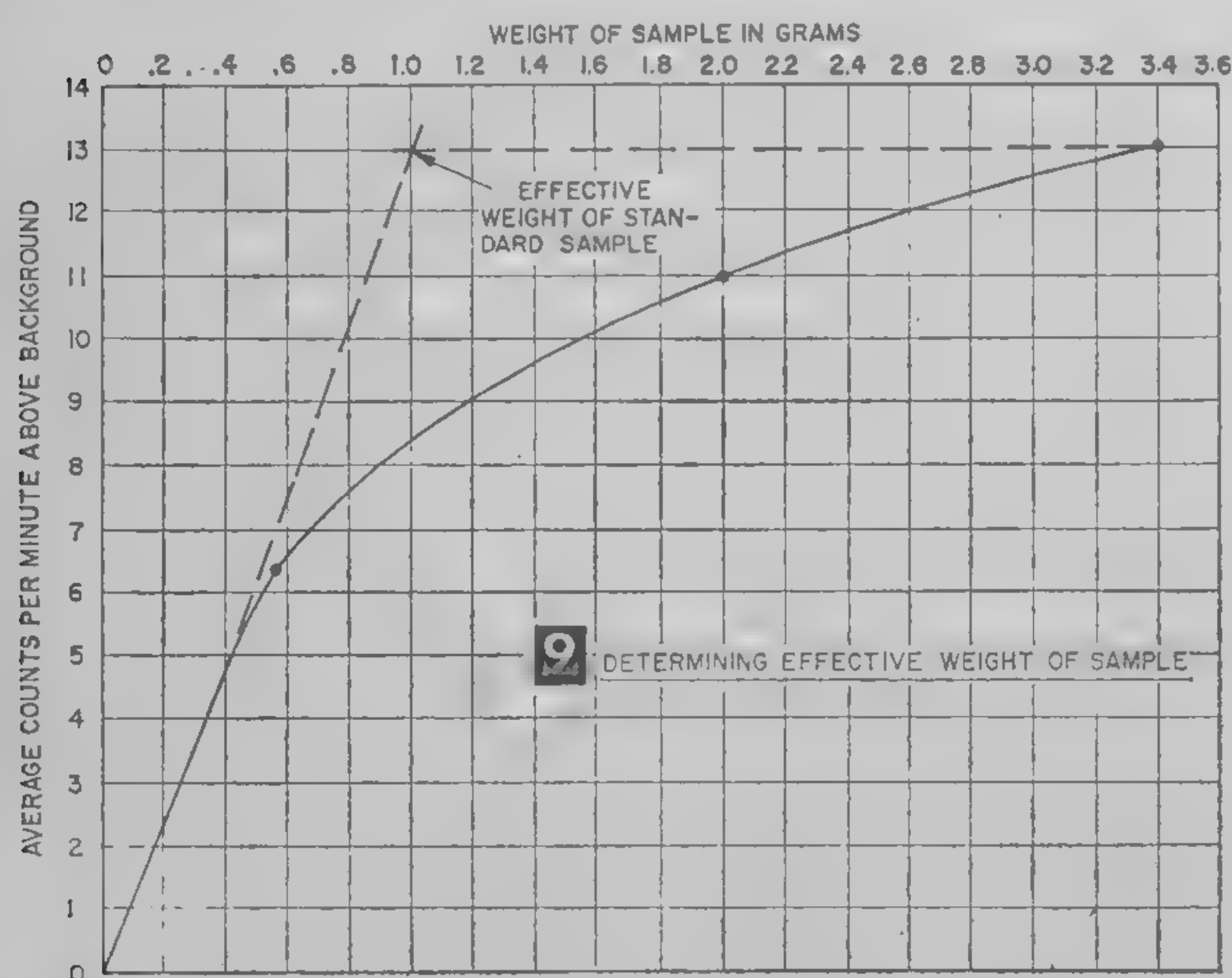
is directly under the tube window. Now, turn on the equipment and let the counting apparatus run for 10 minutes for each reading for each sample.

Take several readings for each sample to improve the accuracy, divide by 10 and plot them as shown in Fig. 6. Also, take at least two readings of normal background radiation and plot them on the same chart.

Since the sample and background readings are obtained by chance ionization of the Geiger tube, it is necessary to average the several readings to determine true trends.

For the chart in Fig. 7, all the readings above the average background for each week were averaged, and these weekly averages were again averaged to get a monthly figure. This graph gives a good picture of the fluctuation of radioactivity in the milk.

Calibrating the Equipment. The readings taken by the Geiger tube are of little value until they are converted to micromicrocuries so they can be compared with Health Service data. I used an inexpensive calibrated radium standard kit. It consists of several metal discs with a square of radium-impregnated silver foil cemented to each.



The standards I used were 20 and 100 micromicrocuries.

Figure 8 shows the two points obtained by taking Geiger readings with each of the discs. Many readings were taken and averaged for each standard, and plotted with micromicrocuries against average counts per minute above the natural background radiation. At zero micromicrocuries, there should be zero counts per minute above background. Therefore, the calibration line begins at zero. The line obtained was determined by a compromise between the two plotted points, since there is no reason for a curve to result. Inset in figure 8 is an enlargement of the lower portion of the graph. This was necessary because my samples covered a range up to only

15½ counts per minute above background.

There is one other point to bring up in calibration. It is necessary to determine if the upper part of the powder sample reduces radiation coming from the lower part. To check this, construct a graph as in Fig. 9. It shows the average counts per minute above background, plotted against the weight of the sample in grams.

A sample weighed 3.35 grams, and for one day's sample, the count was 13. This is shown by the point on the upper right of Fig. 9.

By placing cardboard discs at the bottom of other milk caps and adding more of the same day's sample, two additional thicknesses or weights were obtained. I weighed, counted and plotted these on the graph. The curve shows there *was* some shielding by the upper portion of the 3.35-gram sample. I assumed that zero sample weight should give zero counts per minute above background.

Note that the curve goes up sharply at first, indicating the region where very thin samples would cause very little self-shielding. When this initial straight line is extended upward and a horizontal line is extended from the point of the 3.35-gram sample, the point of their intersection indicates the effective weight of the sample if no self-shielding were present. This effective weight, surprisingly, turned out to be very close to one gram.

Analyzing the Results. Figure 10 is a partial summary of the data I obtained, plus some additional facts derived from it. To obtain the amount of radioactivity in a liter of

milk (column 6), divide micromicrocuries for each sample having an effective weight of grams of milk in a liter.

As proof of the reliability of the equipment, the radium samples hit a peak in the sample. That same month the air from atomic weapons over the Pacific Ocean during the summer of 1958 also reached the coast.

For September, 1958, the following table reported the following results in micromicrocuries per

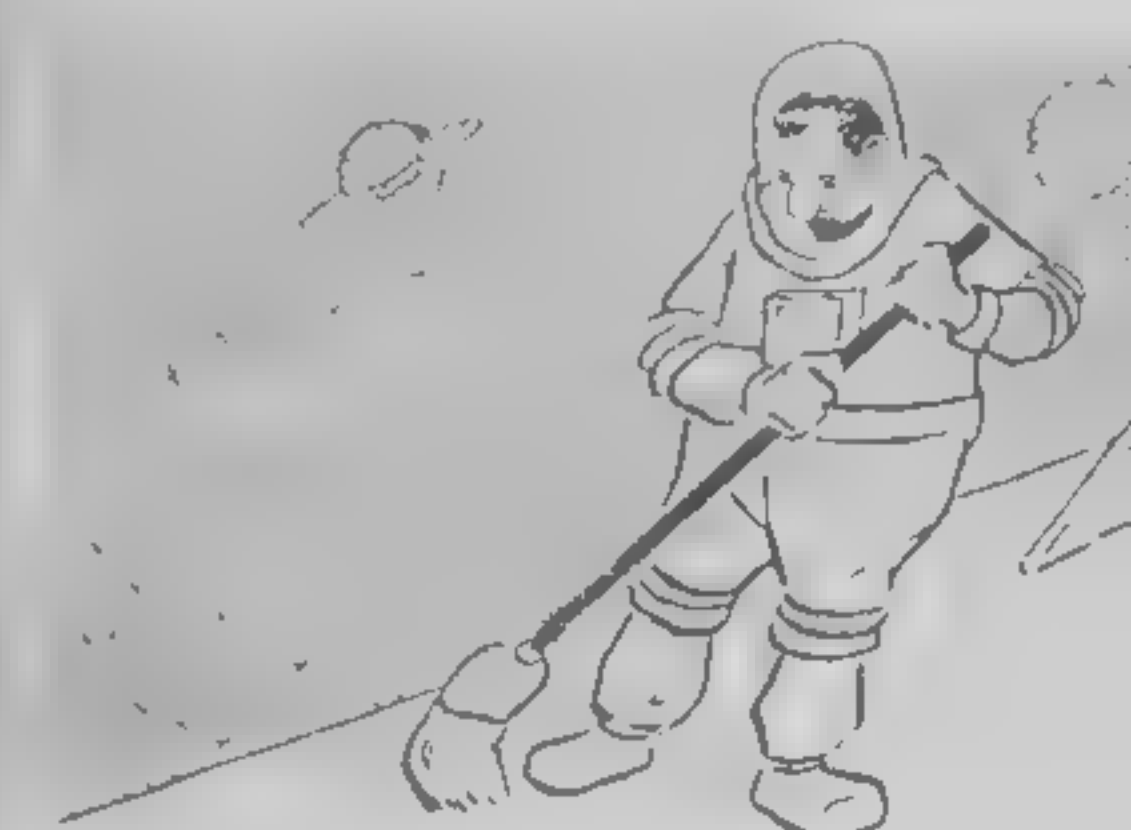
Test

Here's a quiz that will test your facts about such various subjects.

By SHIRLEY

How much dust is there in outer space?

The blanket of interplanetary dust just above the earth's atmosphere



contain 200,000 specks per cubic centimeter, each traveling about 7 miles per second.

vv

Do migrating geese fly the same route north as south?

No. Canadian geese flying south out of their way to stop at feeding grounds. But when they fly back north, the mating instinct drives them to more direct routes—where they stop for food and rest.

vv

Are yogis alert during their state of deep meditation?

Yes. Dr. Basu Bagchi of the University of Michigan says the mystics—who may remain in a state of meditation for up to two hours—are fully alert during meditation. Brain wave measurements show they do not sleep, not even drowsy, although their breathing rate may drop to four per minute.

standards I used were 20 and 100 micromicrocuries.

Figure 8 shows the two counts obtained by taking longer readings with each of the discs. Many readings were taken and averaged for each standard, and plotted with micromicrocuries against average counts per minute above natural background radiation. At zero micromicrocuries, there should be zero counts per minute above background. Therefore, the calibration line begins at zero. The line obtained was determined by a compromise between the two plotted points, since there is no reason for a curve to result. In figure 8 is an enlargement of the lower portion of the graph. This was necessary because my samples covered a range up to only 100 counts per minute above background.

point to bring up in calibration to determine if the upper sample reduces radiation appreciably. To check this, counts were taken for 9. It shows the average counts per minute above background, plotted against sample weight in grams. For one day's work, this is shown by the curve of Fig. 9.

discs at the bottom of the container, adding more of the same additional thicknesses or weights. I weighed, counted and plotted. The curve shows that by the upper portion of the graph, a 100 gram sample. I assumed that the sample weight should give the same counts per minute above back-

ground. The curve goes up sharply, indicating the region where the samples would cause self-shielding. When this curve is extended up to a horizontal line is extended to the point of the 3.35-gram sample, the point of their self-shielding indicates the effective weight of the sample if no self-shielding is present. This effective weight, turned out to be 100 grams.

The Results. Figure 10 is a summary of the data I obtained. It contains some additional facts about it. To obtain the radioactivity in a liter of

milk (column 6), divide the number of micromicrocuries for each sample by 40 (the weight of milk needed to produce a sample having an effective weight of 1 gram). Then multiply by 1000—the number of grams of milk in a liter.

As proof of the reliability of this measuring equipment, the radioactivity in my milk samples hit a peak in the July, 1958, sample. That same month, radioactivity in the air from atomic weapons tests in the Pacific Ocean during the spring and early summer of 1958 also reached a peak.

For September, 1958, the Public Health Service reported the following total radioactivity figures in micromicrocuries per liter of milk: St. Louis,

COLUMN 1	COLUMN 2 A	COLUMN 2 B	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
MONTH	RADIOACTIVITY OF SAMPLE (ABOVE BACKGROUND)		EFFECTIVE SAMPLE WEIGHT	MILK NEEDED FOR 1 GRAM OF EFFECTIVE SAMPLE	MILK RADIOACTIVITY IN MMC PER GRAM	MILK RADIOACTIVITY IN MMC PER LITER
	(FROM FIG 7)	(FROM FIG 8)	(FROM FIG 9)			
JULY	COUNTS/MIN	* MMC	1 GRAM	40 GRAMS	0.23	230
	15.5	9.3				
AUG	12.0	7.2	11	11	0.18	180
SEPT	13.0	7.8	11	11	0.195	195

10 DATA USED TO COMPUTE ABSOLUTE RADIOACTIVITY IN MILK
MMC * = MICROMICROCURIES

Mo.—469; Chicago, Ill.—196; Atlanta, Ga.—192, and Cincinnati, Ohio—184. My finding of 195 fits in well, showing the radioactivity in Washington, D. C., milk was about the same as that in Chicago and Atlanta.

Test Your Science Knowledge

Here's a quiz that will test your knowledge of the scientific facts about such varied subjects as owls, yogis and eggs

By SHIRLEY MOTTER LINDE



How much dust is there in outer space?

The blanket of interplanetary dust just above the earth's atmosphere may



contain 200,000 specks per cubic mile, each traveling about 7 miles per second.

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Do migrating geese fly the same route north as south?

No. Canadian geese flying south go out of their way to stop at certain feeding grounds. But when they head back north, the mating instinct impels them to more direct routes—with fewer stops for food and rest.

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Are yogis alert during their state of deep meditation?

Yes. Dr. Basu Bagchi of the University of Michigan says the Indian mystics—who may remain immobile for up to two hours—are fully alert during meditation. Brain wave measurements show they do not sleep, are not even drowsy, although their breathing rate may drop to four per minute.

How long have parachutes been used?

First recorded use of a parachute is in an ancient Chinese legend that tells of a young lover eluding an angry father by jumping from a high wall with two large coolie hats in each hand. A parachute similar to today's was designed in 1495 by Leonardo da Vinci. And in 1810, a Polish balloonist named Kuparento became the first aerialist to leap to safety with a parachute.

vv

How much time do you spend blinking?

If you're the non-worrying type, you may spend as much as 15% of your waking time in darkness—due to blinking—according to the Vision



Conservation Institute. But if you're under emotional strain, you may blink more than 35% of the time. Men, incidentally, blink more than women, possibly because of business tensions.

Is the owl wise or otherwise?

The proverbial "wise old owl" is actually pretty bird-brained. Despite his reputation for wisdom, his mental processes are almost entirely devoted to seeing and hearing. The part of his brain used for thinking is very small.

vv

How much water evaporates from a 1,000-acre lake in a year?

More than a billion gallons in cool climates; twice that in warmer regions. Local and federal agencies trying to help save our water supply are investigating the use of a waxy hydrocarbon to form a protective surface film on lakes, thereby decreasing evaporation.

vv

How can you tell if an egg is cooked or raw—without breaking the shell?

Lay it on a table and try to give it a whirl. If it spins easily, it's cooked. A raw egg doesn't spin readily because the viscous fluids inside the shell dissipate the rotational energy.

vv

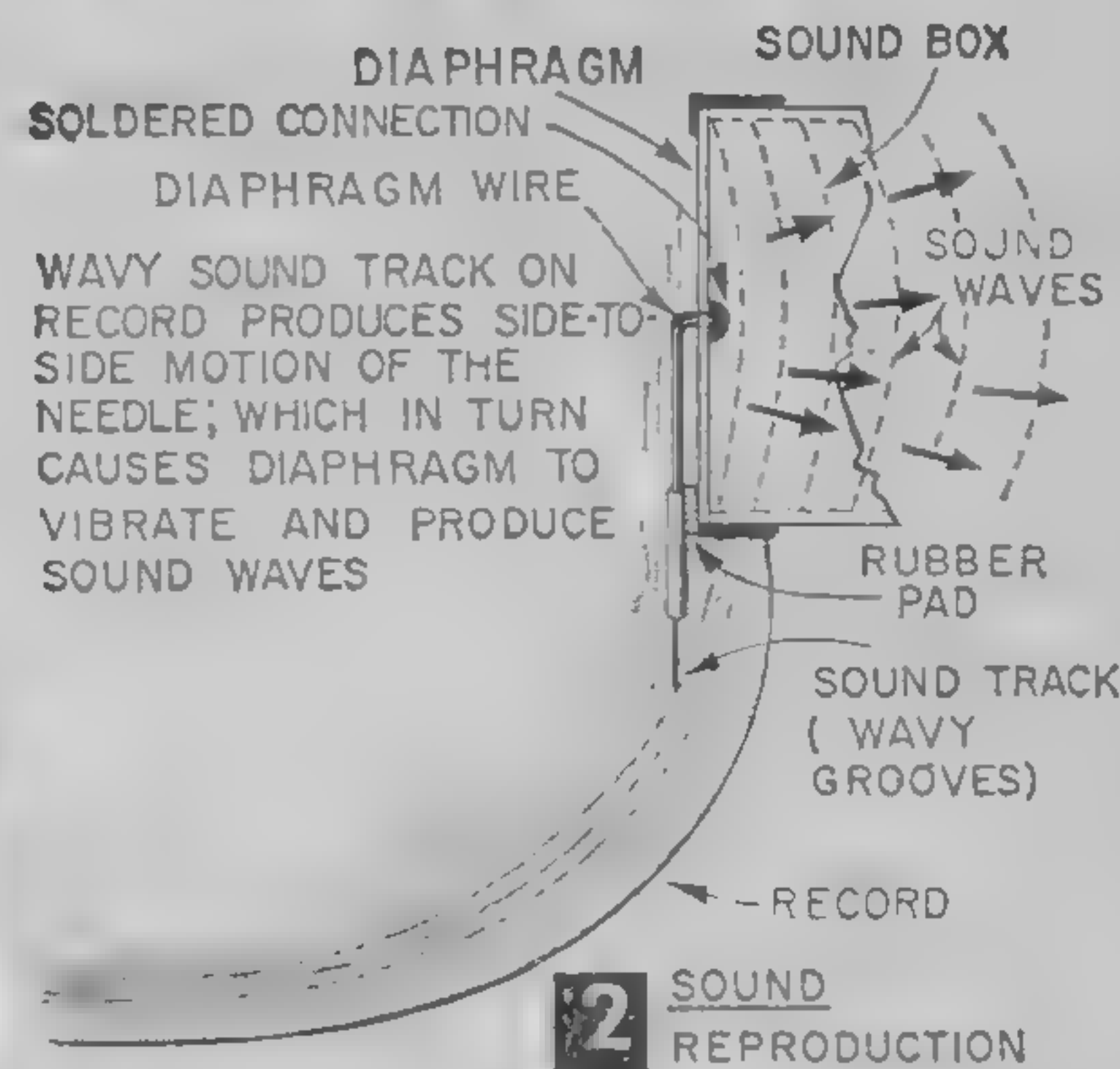
How long does a sloth sleep?

The slothful sloth spends as much as 18 hours a day snoozing peacefully as he hangs upside down from a tree limb. To protect him while he sleeps, he has a built-in camouflage: the coarse brown hairs of his fur have tiny cracks, in which grayish-green algae live, giving him just the right color to blend in with the jungle background.

Hand-Operated Phonograph Is Science Teaching Aid



Varying the rotating speed of the record on this hand operated phonograph can produce some weird and comical sounds, and demonstrates the need for constant speed in sound reproduction.



Fasten rubber feet at each corner of the base to act as vibration dampeners.

Cut out two $3\frac{3}{8}$ -in. dia. pulleys from $\frac{1}{2}$ -in. pine using a jigsaw, and make a $\frac{1}{8}$ -in. groove around the circumference of each with a lathe or round file (Fig. 3). Drill a hole in the center of one of the pulleys to permit a running fit with the #14 woodscrew. Also drill a $\frac{1}{4}$ -in. hole in this same pulley, and glue and drive in this hole a $\frac{1}{4} \times 1\frac{3}{4}$ -in. dowel handle. Fasten this pulley (drive pulley) to the base with the #14x1-in. woodscrew and two washers. A

CALCULATED to hold a student's interest while teaching the basic fundamentals of phonographic sound reproduction, this physics lab apparatus (Fig. 1) can be made of scrap materials in a few hours.

Our hand-operated phonograph uses standard 78 rpm records and, like Edison's 1877 model, no electrical application is involved.

This phonograph has a needle that runs in a sound track made on the record by a cutting needle during recording (Fig. 2). These sound vibrations thus picked up by the phonograph needle are identical with those recorded, and are transmitted from the needle to an aluminum diaphragm by a metallic wire. From the diaphragm, they pass through the sound box to the horn where they are amplified.

Making the Phonograph. Make the base from a piece of $\frac{1}{2}$ -in. plywood (Fig. 3). Lay out the base for the #14x1-in. drive pulley screw, the $\frac{1}{4} \times 1\frac{5}{8}$ -in. spindle dowel, and the $\frac{1}{2} \times \frac{3}{4} \times 3\frac{1}{2}$ -in. arm support. Drill a $\frac{5}{32}$ -in. pilot hole for the drive pulley screw, glue and drive the spindle dowel, and glue and brad the arm support.

MATERIALS LIST—HAND OPERATED PHONOGRAPH

No.	Description	Use
1 pc.	$\frac{1}{2} \times 12 \times 12$ " fir plywood	base
1 pc.	$\frac{1}{4} \times 4$ " hardwood dowel	spindle and handle
1 pc.	$\frac{1}{2} \times 4 \times 8$ " pine stock	pulleys
1 pc.	$\frac{1}{8} \times 10 \times 10$ " hardboard	turntable
1 pc.	$\frac{1}{2} \times \frac{3}{4} \times 3\frac{1}{2}$ " hardwood stock	arm support
4	rubber feet	base support
1 pc.	10 x 10" felt	turntable pad
1	large flat rubber band	belt
1	thin aluminum baking pan (see text)	diaphragm
1 pc.	$2\frac{1}{4}$ " dia. x 6" cardboard mailing tube	sound box
1 pc.	#16 ga. x $1\frac{1}{4}$ " copper or iron wire	diaphragm wire
1	std. 78 rpm phonograph needle	chuck
1 pc.	$\frac{1}{4} \times \frac{5}{8}$ " piece of tin can	chuck support
1 pc.	$\frac{1}{16} \times \frac{1}{8} \times \frac{3}{16}$ " piece of rubber	support arm
1 pc.	wire coat hanger 6" lg.	horn
1 pc.	14 x 24" desk blotter or heavy paper	horn
1 pc.	$\frac{5}{16}$ " I.D. x $1\frac{1}{4}$ " metal or fiber tubing	handle tube
1	#14 x 1" rh woodscrew	drive pulley axle
1	#5 x 1" rh woodscrew	arm to arm support
1	#4-40 x $\frac{3}{8}$ " rh mach. screw w/nut	arm to reproducer
3	$\frac{1}{4}$ " I.D. washers	
Miscellaneous		
	$\frac{1}{2}$ " & 1" brads	aluminum solder
	Pliobond cement	glue
	$\frac{3}{4}$ " wide masking tape	

loosely fitted piece of tu
handle will make crank

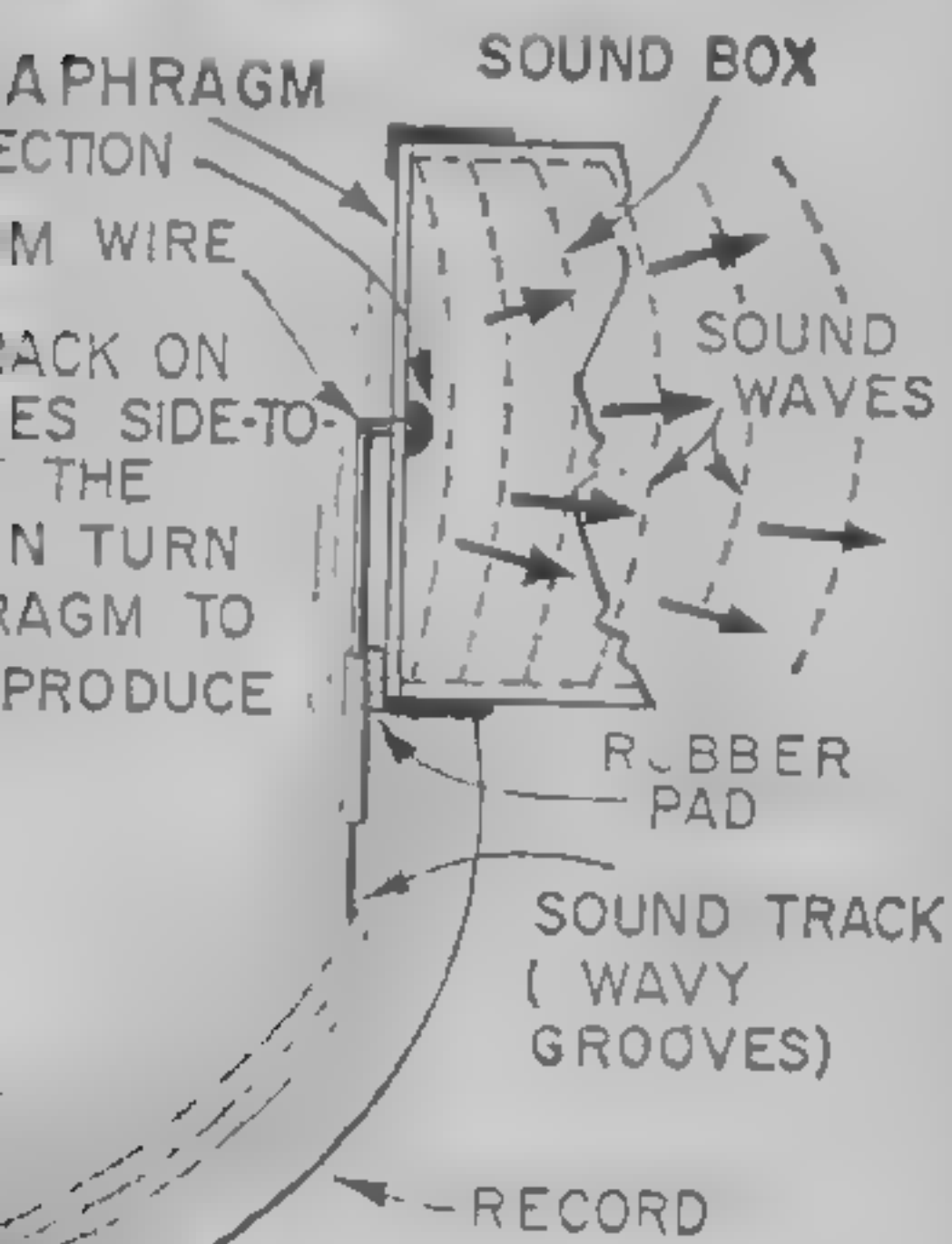
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Line up these two pi
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by placing the rubber
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Now make the repro
box from a $2\frac{1}{4}$ -in. dia.
by first cutting off two
pieces. Then cut one
piece at a 45° angle, an
together at their angle-c
masking tape to form
(Figs. 5 and 6). Next c
in. disc from a thin alumi
pan (as furnished with
mixes), and, after bend
of #16 gage copper or
shown in Fig. 5E, pier
minum disc (diaphragm
tapered end of the wire.
wire to the diaphragm
of aluminum solder.

Make the reproducer s
from a piece of wire
(Fig. 5D). Wrap a piece
tape around one end of
box leaving $\frac{3}{16}$ -in. of th
tending beyond the edge
secure diaphragm later),
the support arm to the
with a #4-40 screw ob
 20° angle made between
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ing tape that was wrap
one end of the sound bo
the diaphragm wire outs
the diaphragm until the
an 80° angle with the s
(Fig. 5B), then, crimp the
masking tape over the
thus securing it to the
Some Pliobond cement a
will insure a better bond.

Form a chuck $\frac{5}{8}$ -in. lon
tightly hold the diaphrag
one end, and a standard 7

Phonograph g Aid



2 SOUND REPRODUCTION

er feet at each corner of
act as vibration damp-

two $3\frac{3}{8}$ -in. dia. pulleys
ine using a jigsaw, and
groove around the cir-
of each with a lathe or
Fig. 3). Drill a hole in
one of the pulleys to
anning fit with the #14
Also drill a $\frac{1}{4}$ -in. hole
e pulley, and glue and
hole a $\frac{1}{4} \times 1\frac{3}{4}$ -in. dowel
ten this pulley (drive
e base with the #14x1-
w and two washers. A

OPERATED PHONOGRAPH

	Use
base	base
spindle and handle	spindle and handle
pulleys	pulleys
turntable	turntable
arm support	arm support
base support	base support
turntable pad	turntable pad
belt	belt
diaphragm	diaphragm
sound box	sound box
diaphragm wire	diaphragm wire
chuck	chuck
chuck support	chuck support
support arm	support arm
horn	horn
handle tube	handle tube
drive pulley axle	drive pulley axle
arm to arm support	arm to arm support
arm to reproducer	arm to reproducer
aluminum solder	aluminum solder
glue	glue

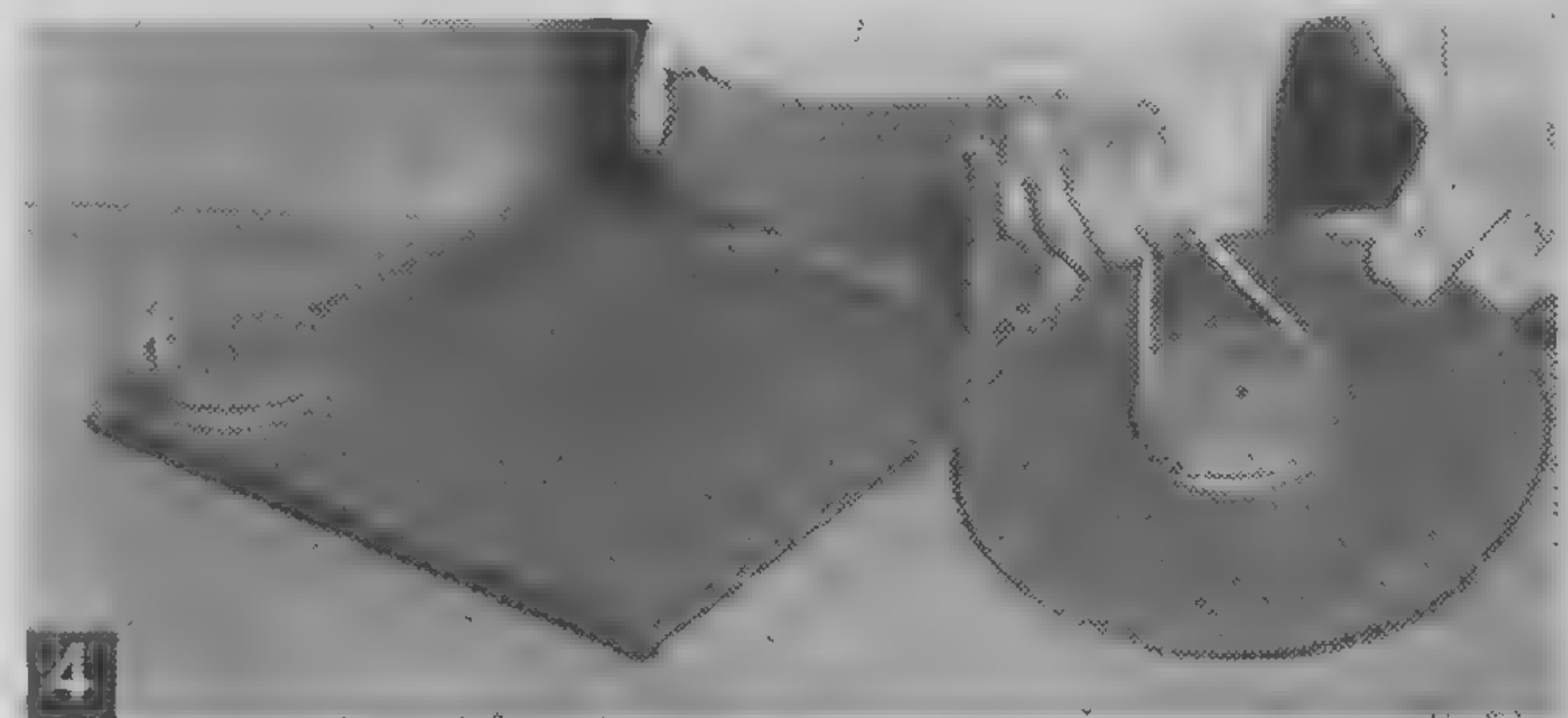
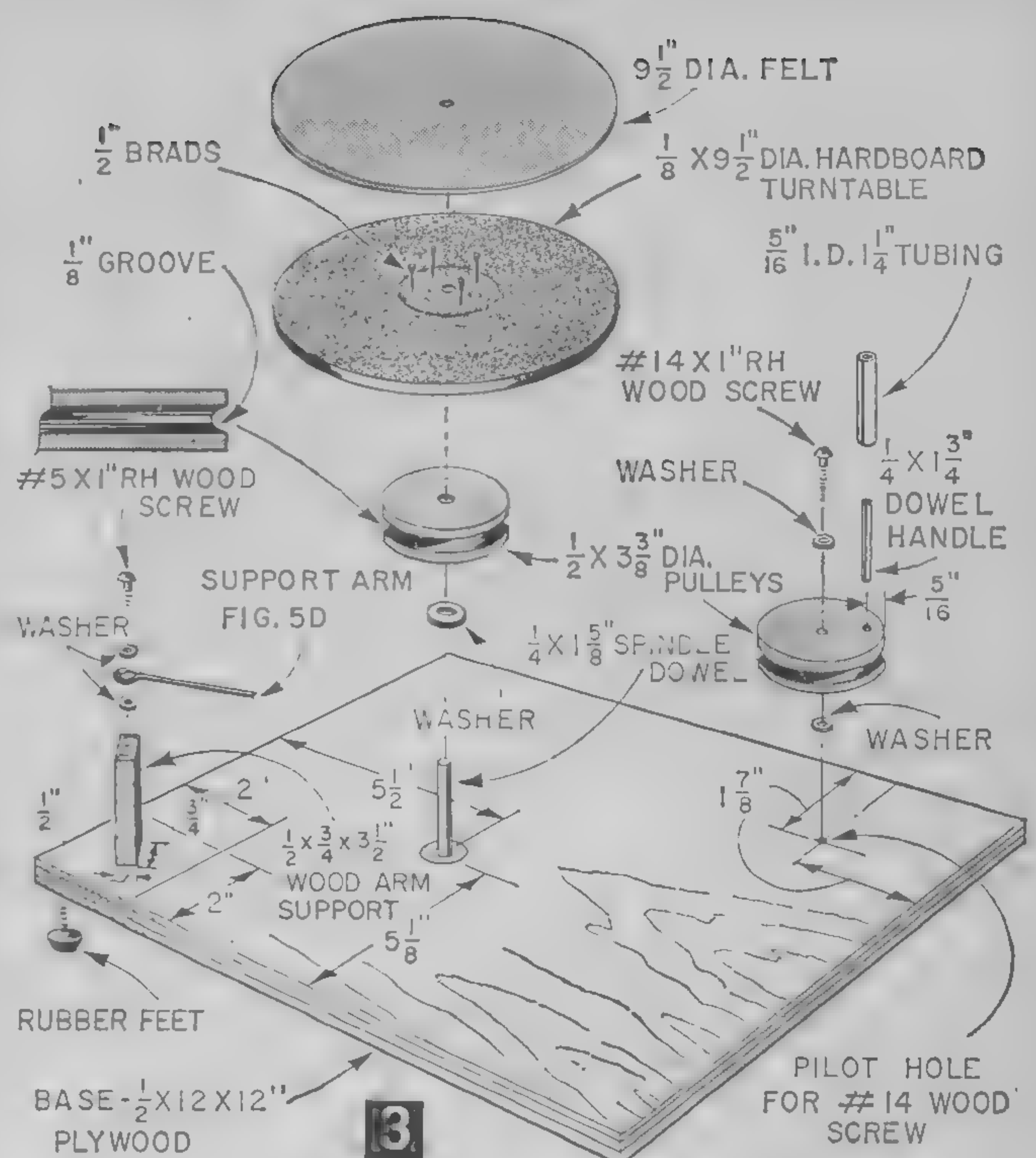
posely fitted piece of tubing over the
andle will make cranking easier.

Make a $9\frac{1}{2}$ -in. dia. turntable from
 $\frac{1}{8}$ -in. hardboard. Drill a $\frac{1}{4}$ -in. hole
in the center of the turntable and
the second pulley (driven pulley).
Line up these two pieces with a
piece of $\frac{1}{4}$ -in. dowel passed through
their center holes, and fasten them
together with $\frac{1}{2}$ -in. brads. Complete
this assembly by gluing a disc of felt
or velvet to the top of the turntable,
and punching out a $\frac{1}{4}$ -in. hole at the
center of the felt. Place a washer
over the spindle and lubricate both
with powdered graphite, then, hold-
ing a large rubber band around the
driven pulley (Fig. 4), drop the turn-
table down over the spindle, and
connect the drive and driven pulleys
by placing the rubber band in the
pulley grooves.

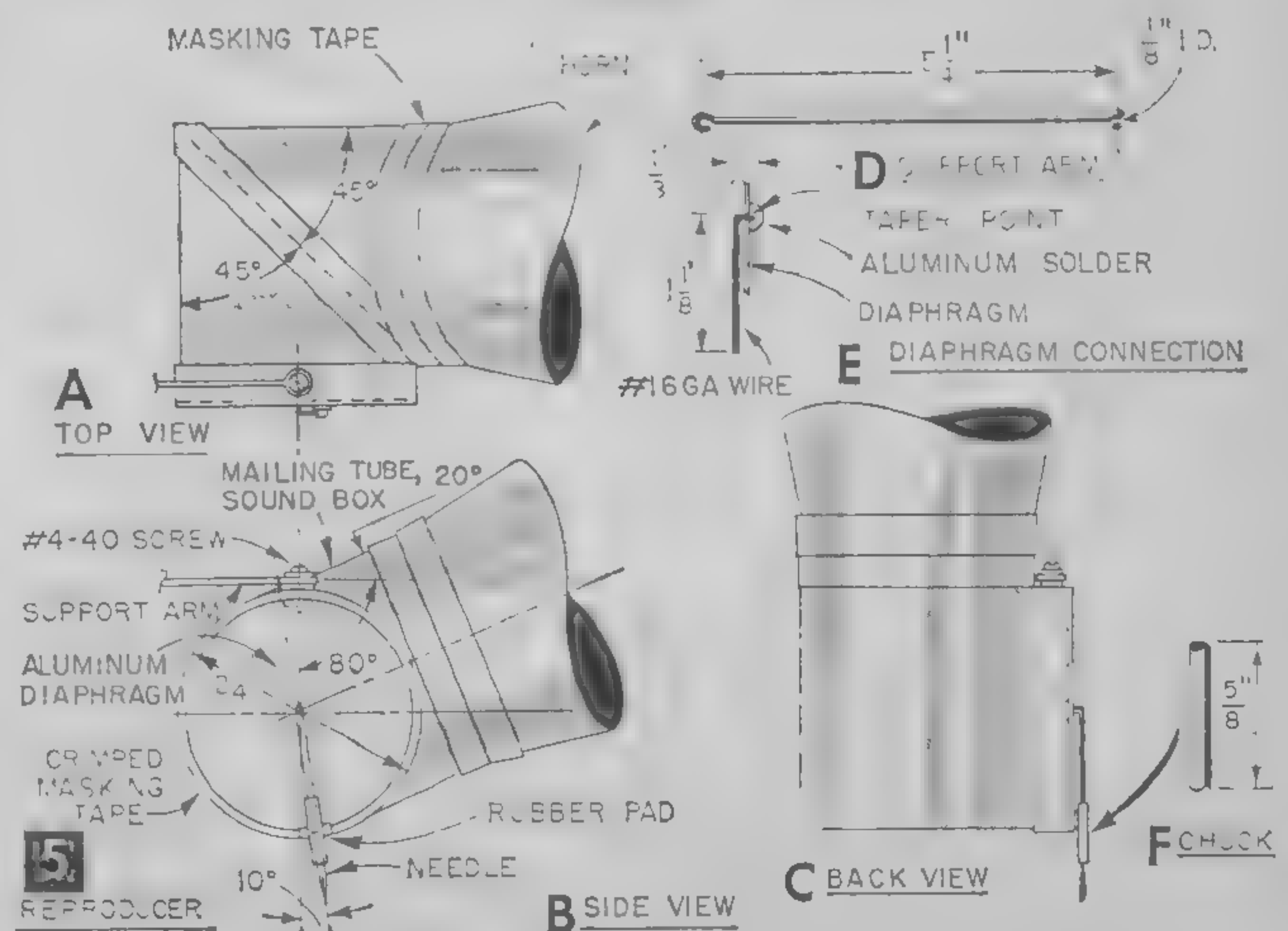
Now make the reproducer sound
box from a $2\frac{1}{4}$ -in. dia. mailing tube
by first cutting off two $2\frac{5}{8}$ -in. long
pieces. Then cut one end of each
piece at a 45° angle, and join them
together at their angle-cut ends with
masking tape to form a 90° elbow
(Figs. 5 and 6). Next cut out a $2\frac{1}{4}$ -
in. disc from a thin aluminum baking
pan (as furnished with cake ready
mixes), and, after bending a piece
of #16 gage copper or iron wire as
shown in Fig. 5E, pierce the alu-
minum disc (diaphragm) with the
tapered end of the wire. Fasten the
wire to the diaphragm with a drop
of aluminum solder.

Make the reproducer support arm
from a piece of wire coat hanger
(Fig. 5D). Wrap a piece of masking
tape around one end of the sound
box leaving $\frac{3}{16}$ -in. of the tape ex-
tending beyond the edge of tube (to
secure diaphragm later), then fasten
the support arm to the sound box
with a #4-40 screw observing the
 20° angle made between the support
arm and the horn end of the sound
box (Figs. 5 and 6). Place the dia-
phragm inside the extended mask-
ing tape that was wrapped around
one end of the sound box, keeping
the diaphragm wire outside. Rotate
the diaphragm until the wire makes
an 80° angle with the support arm
(Fig. 5B), then, crimp the extending
masking tape over the diaphragm
thus securing it to the sound box.
Some *Pliobond* cement applied first
will insure a better bond.

Form a chuck $\frac{5}{8}$ -in. long that will
tightly hold the diaphragm wire in
one end, and a standard 78 rpm pho-



The complete base section and turntable ready for assembly. A large flat rubber band acts as the "belt" between drive and driven pulley.



nograph needle in the other end by rolling a piece of metal taken from a tin can around a wire (Fig. 5F). Slide the chuck for half its length onto the diaphragm wire, and insert the phonograph needle in the other end, then, place some *Pliobond* cement on a small piece of rubber, and wedge it in between the chuck and the edge of the diaphragm so it will act as a resilient support for the diaphragm wire and needle (Figs. 5B and C). Make a 12-in. long horn by first rolling a piece of desk blotter or other stiff paper

into a cone, and use glue or masking tape to hold it together. Then, cut off the cone end to fit the sound box, trim the large end even, and fasten horn to sound box with masking tape (Fig. 5).

Complete the phonograph by loosely fastening the reproducer arm to the arm support with a #5x1-in. *rh* screw and washers, and adjust the needle to record contact pressure by bending arm until the needle rests lightly in the record grooves, and can also follow the grooves across the record when in operation.—H. P. STRAND.

Cooling Water ... to a Boil

BOIL water with a piece of ice?

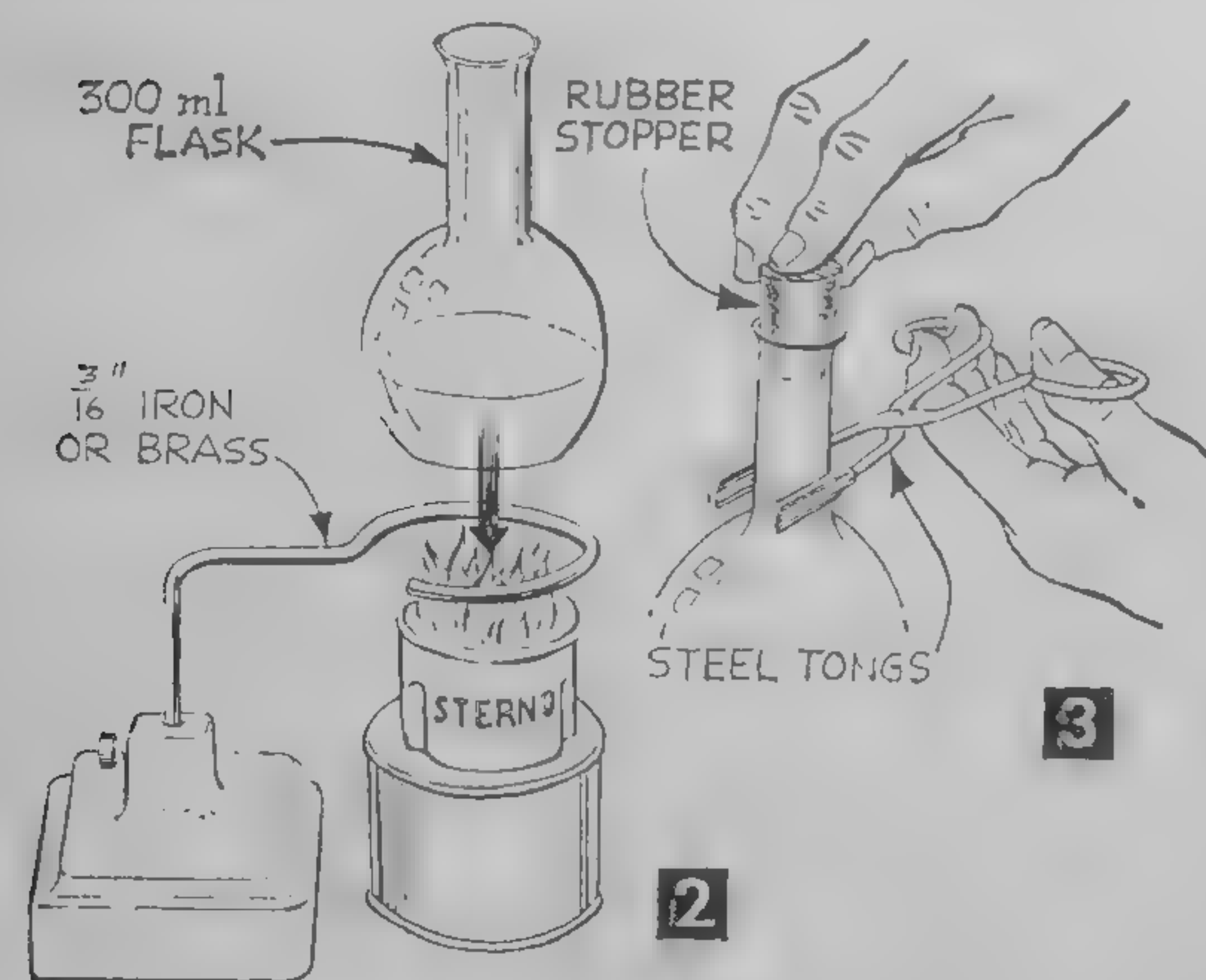
There's a way to do it, and you can demonstrate an interesting scientific phenomenon by trying the experiment.

First, bend up from $\frac{3}{16}$ -in. diameter wire a circular support for a flat-bottom Pyrex flask (Fig. 2). The height of the stand and the support wire loop should allow the neck of the flask, when inverted, to clear the bench by at least $\frac{3}{4}$ in. (Fig. 1). Use a can of Sterno heat, elevated on another empty can as in Fig. 2, to bring the flame quite close to the bottom of the flask.

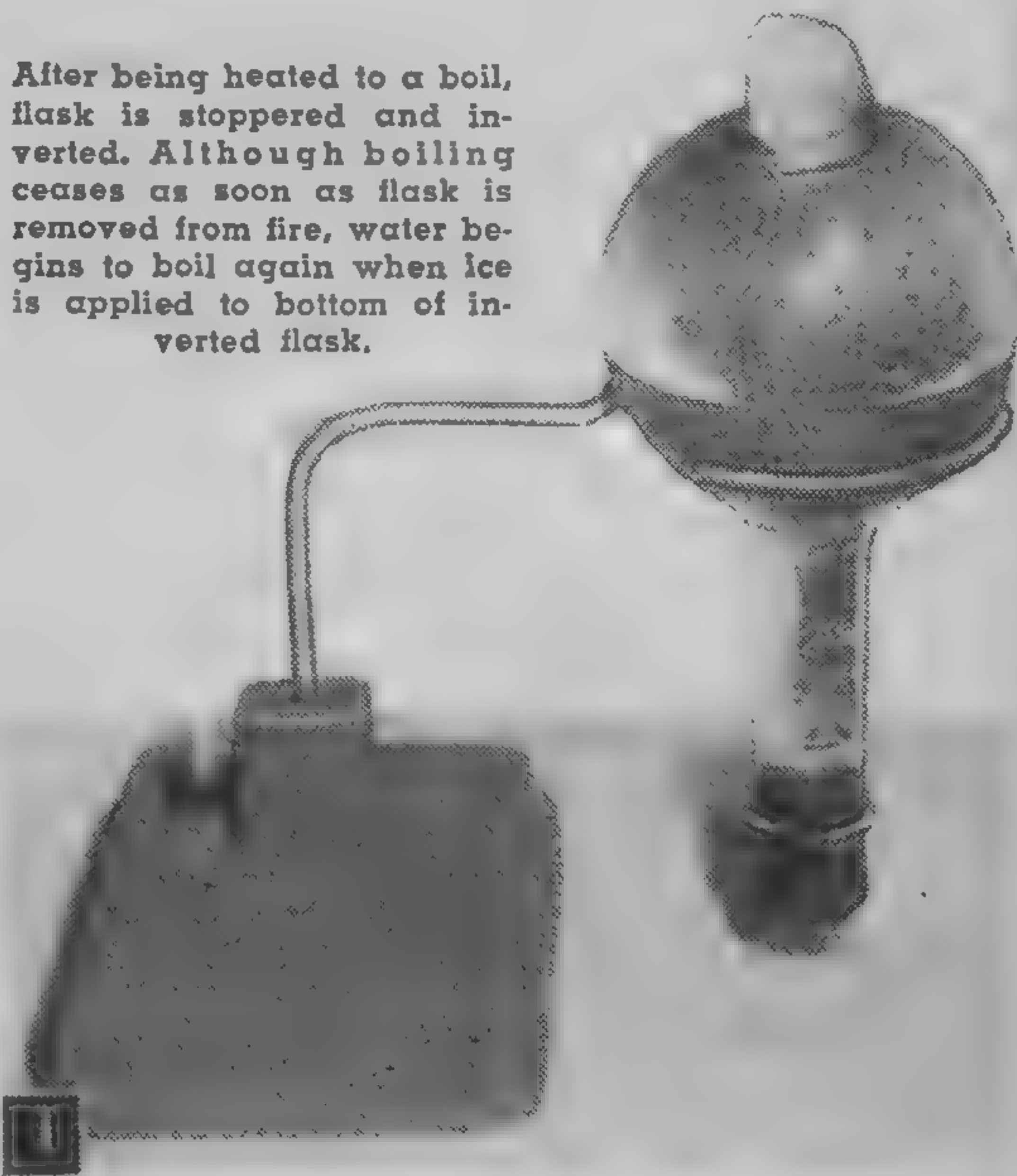
Fill flask about one-half full. Next, observing normal fire precautions, light Sterno under flask and let water come to a boil. Then put out flame by replacing the cover on Sterno can and tightly press solid rubber stopper (#4 size for this 300 ml flask) in the neck of the flask (Fig. 3).

Invert the stopper flask and place it on the wire loop as in Fig. 1. Note that the water has stopped boiling.

Now place an ice cube on the flat bottom of the flask. In a few seconds, the water will start to boil again just as though you had placed it back over the flame.



After being heated to a boil, flask is stoppered and inverted. Although boiling ceases as soon as flask is removed from fire, water begins to boil again when ice is applied to bottom of inverted flask.



The Principle Involved here is that cooling condenses the steam or water vapor above the water and reduces the pressure on the water. At reduced pressure water will boil at a lower temperature (it is easier for bubbles to form), so the water starts to boil again.

Measuring the Temperature. If you use a one-hole rubber stopper in the flask, in place of the solid one shown, you can press a laboratory thermometer in the stopper hole. Then arrange the wire ring to support the flask a little higher to allow clearance for the thermometer when the flask is inverted. Thus you can record the reduced temperature at which the water boils when ice is applied to the flask.

In my own tests, when the water boiled over the flame, the thermometer showed 212° F. Boiling stopped when flame was removed but started almost immediately when ice was applied. The boiling with ice continued while the thermometer dropped down to 130° F., then ceased.

This principle is used in the preparation of food products (evaporated milk, sugar, syrups, etc.). Prepared under low pressure, water can be removed at comparatively low temperatures; this eliminates the possibility of damaging the product by exposure to high temperatures.—H. S.

HOW

Building a tandem guard
fun. Only the front handle

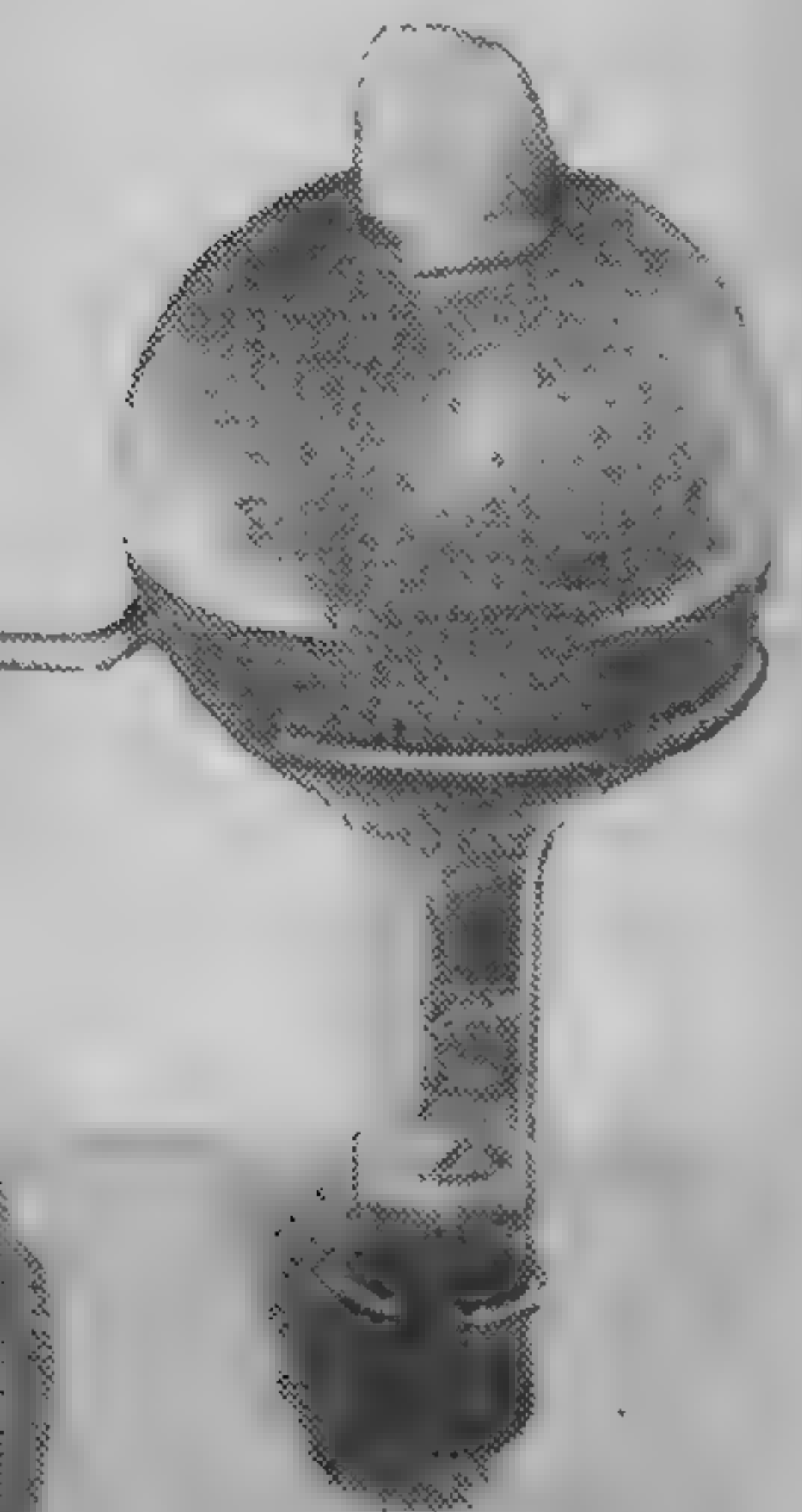
Put
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By HAROLD

EVERYONE in your
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spending \$150, you can
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As you begin this pr
there is no shortage of u

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H. P. STRAND.

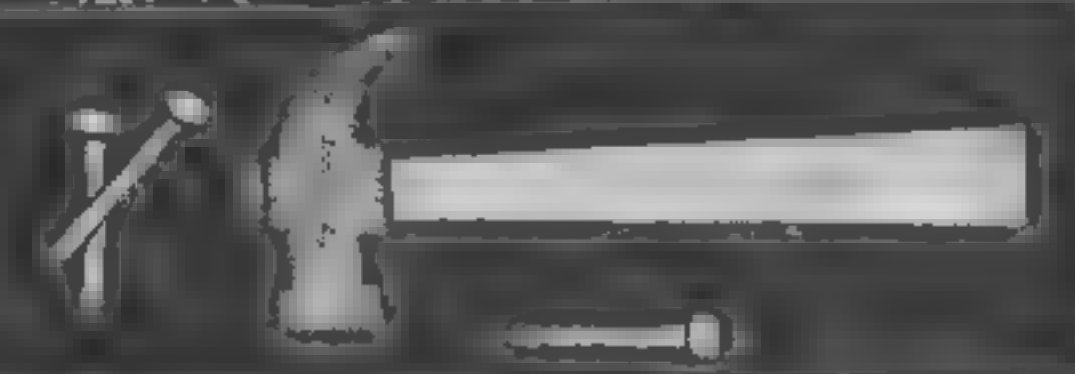


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the preparation of food
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temperatures.—H. S.

HOW TO DO IT



Tandem Bicycle



Building a tandem guarantees you'll get outdoors this summer for plenty of healthful exercise that's lots of fun. Only the front handlebars steer, but both pedals control the coaster brake of this easy-handling, showy bike.

Put more fun and healthful zip into your family living with this bicycle built for two

By HAROLD P. SMITH

EVERYONE in your family will enjoy taking part in the popular revival of this gay-nine-ties sport—riding a tandem; instead of spending \$150, you can build it from salvaged bikes and a few dollars' worth of extra parts.

As you begin this project, you will find that there is no shortage of used bikes and parts. Not

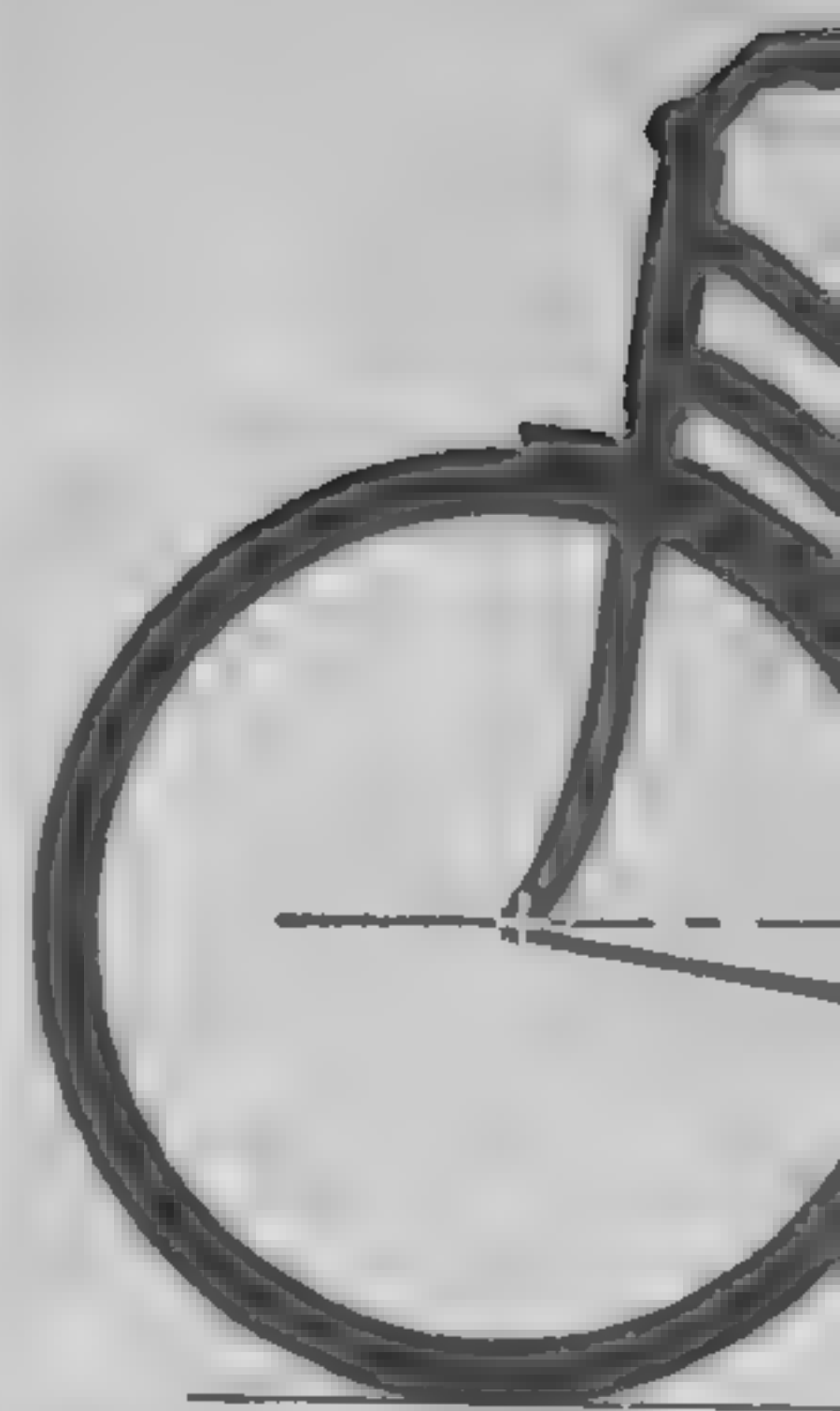
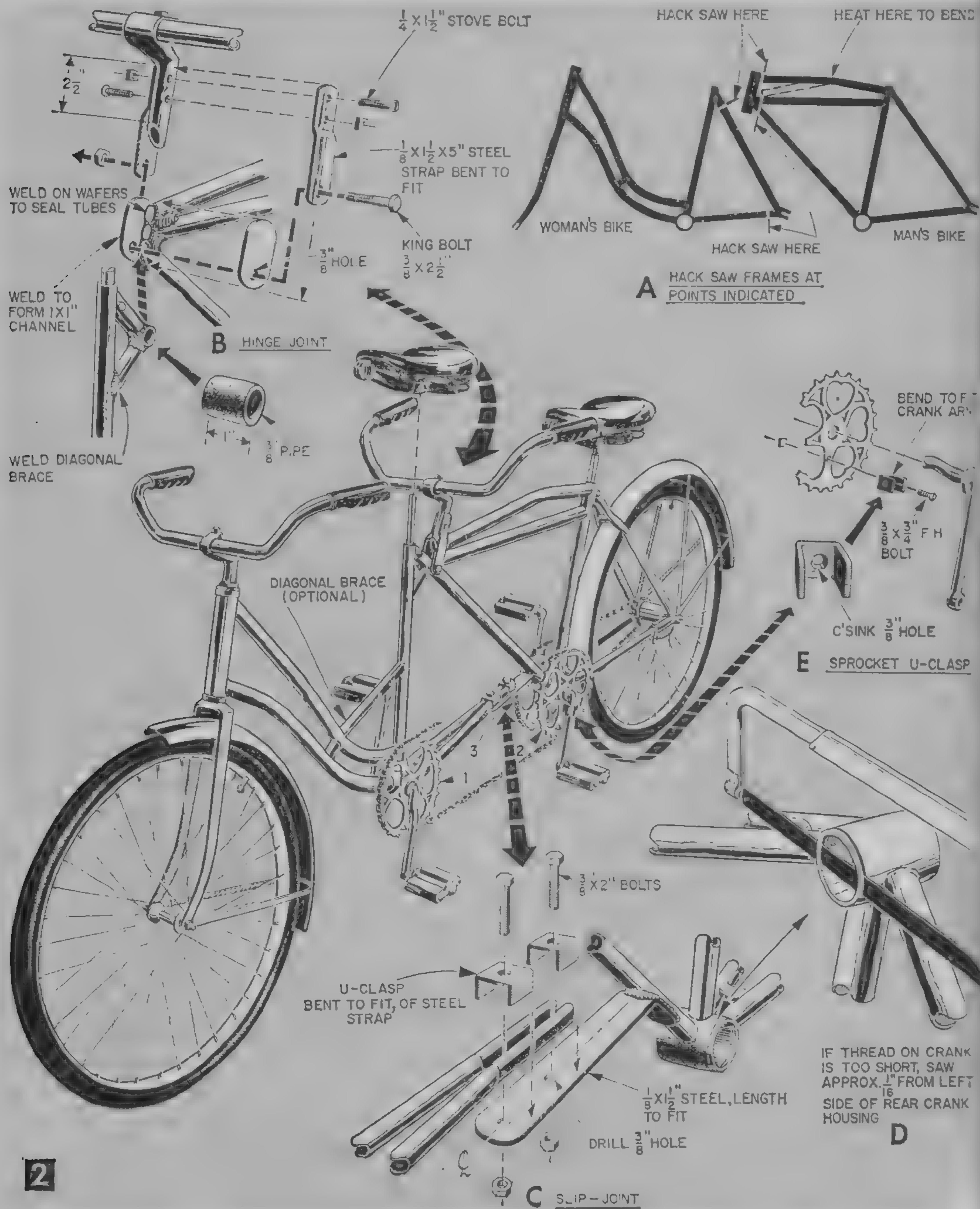
only garages and basements but junk yards are rich sources. Often, bikes are discarded after only minor damage has occurred, and you can buy them for a few dollars. And of course, new stock parts are readily available from cycle shops and mail order houses.

Construction does not require a well equipped shop. Every step, except the welding of five joints, can be done with a hacksaw, a vise, hand tools, and an electric drill. The welds are easily done with a light duty home welder, or you can

saw the parts to fit, and take them to a neighborhood garage, or metal shop, where the work should cost no more than a few dollars. The extra metal joints and parts are sawed, for simplicity, from one 3 ft. length of $\frac{1}{8} \times 1\frac{1}{2}$ -in. steel flat stock, available in many hardware stores.

You will need two bike frames, a woman's drop frame bike for the front portion, and a man's diamond frame bike for the rear, to build

the tandem as shown in Fig. 1. The drop frame is suggested for the front, because it permits a rider to get on without the difficulty of lifting a leg over the extra handlebars in the rear. Select two bikes as alike as possible. They must have the same size wheels, and sprockets, and ought to be the same make and vintage so the parts will match. It would be best to choose American-made bikes, since foreign makes are scarcer, the



3 FRAME SPACING ADJ.

parts more costly, and As shown in Fig. must be equal in size one as well as and paired drive sprockets one crank would re making it impossible also could cause one sharp turns. While 3 equal in size to smaller sprocket in less speed, with the torque.

Start construction frames completely. I on bikes, it would parts and to take c together. Also, this bearings for dirt and parts for damage, so replacements.

The front wheel fo be used. With a hack tube into which the f as close as you can, t

Then, if your bike carefully bend the to ond one (Fig. 2A). torch to redness at t sawed ends of the th imately even. To k open tube ends by w as knockout discs fro

The two bike fram together by means of Fig. 4), which will p in the front chain a use. The hinge joint made from two pieces ners rounded. Weld tubes as in Fig. 2B, to about 1 in. deep and ing is finished, drill a the center line of through both plates.

Figure 2A shows v frame of the woman's

D

SCIENCE AND MECHANICS

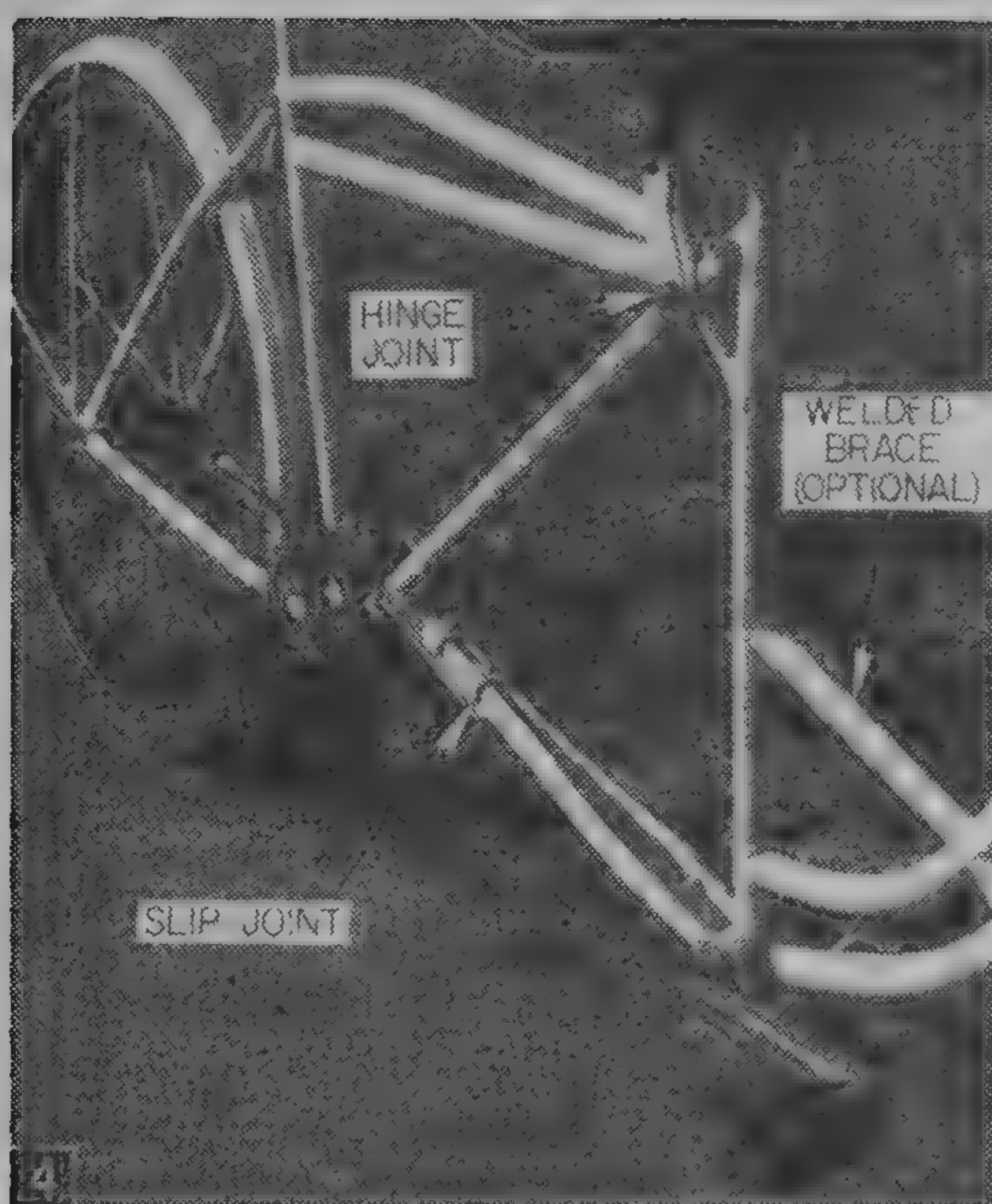
3 FRAME SPACING ADJUSTMENT

Figure 2A shows what to saw away from the frame of the woman's bike used up front. Keep

MATERIALS LIST—TANDEM BICYCLE

No.	Req'd	Description
1		man's bike, full size 26" complete
1		woman's bike, full size 26" complete except for wheels*
1		extra drive sprocket, & drive chain to match above
1		3' length, 1 1/2 x 1/8" cold rolled (#1018) flat steel (some- times called steel strap metal)
1		3/8" x 24 thd. x 2 1/2" hex head steel cap screw & nut
1		3/8" x 24 thd. x 2" hex head steel cap screw & nuts
1		3/8" x 24 thd. x 3/4" hex head steel cap screw & nut
1		1/4" x 28 thd. x 2 1/2" hex head steel cap screw & nut
2		1/4" x 20 thd. x 1 1/2" rh stove bolts & nuts

Now, you are ready to set up the assembly of the two frames. Reinstall the front fork in the forward frame. Hinge the two frames together with the kingbolt and lay them flat on the floor. With a 6-ft. straight edge, align the frames so their crank housings will come slightly below a straight line running between the front and rear axles (Fig. 3). Positioning should be such that the revolving pedals clear the ground by about 5 in. Otherwise, if the barrels ride too high, the



overall tandem height is unduly increased. Move your slip joint plate into contact with the diagonal tube of the rear frame, tighten the U clasps down, check the alignment and weld the plate to the tube. Make a strong weld since it will bear much of the weight of the riders.

Reassemble the bike parts, beginning with the front crank, which must be reversed in its barrel, with the drive sprocket on the left side of the frame. Use #3 cup grease on the bearings, and check them for flaws and dirt. The assembly should turn freely, but should not shake in its housing. Tighten the lock nut well, since it will be turning opposite to its original direction.

IMPORTANT NOTE: When adjusting bike hub, crank, or head bearings, first tighten down the bearing cones until they just begin to bind. Then back one cone off about a quarter turn before tightening the retaining nut. If bearings are installed too tightly, they will freeze, or may be damaged.

Install the rear crank as it was originally, with the drive sprocket on the right side. Clean the bearings making sure they are in good condition. Adjust the crank bearing cone to the proper tightness—so it turns freely, but feels mechanically firm. Then, install the spare sprocket next to the bearing cone, and install and tighten the retaining lock nut. The sprocket may bind on the crank housing. If so, shim it out from the bearing cone so it has clearance to turn freely. If you have insufficient thread on the crank for the retaining nut, hacksaw a ring about $\frac{1}{16}$ -in. thick (Fig. 2D) from the left end of the crank barrel. To do this, you will have to drive out the left crank bearing cup with a hammer and soft piece

of wood. In most American bikes, the bearing raceway is a force fit, and can be removed easily.

To keep the extra sprocket from slipping under load, make a U-clasp (Fig. 2E) of steel strap, just wide enough to fit the crank arm snugly. Drill a $\frac{3}{8}$ -in. hole in the bottom of the clip and bolt it to the lug hole of the sprocket. You may need to thin down the nut so it can pass frame parts as the sprocket rotates, and if the extra sprocket itself scrapes on the chain stay, dent the tubing in with a flat nose punch.

The middle handlebar (Fig. 2B) is required for support only, not for steering, and is fastened by brackets which must clear the front saddle springs. Using a saddle with shallow springs in front, will give you more space. Saw the butt of your extra handlebar post down to a length of 2½ in. Then cut two 5-in. lengths of steel strap, clamping one on either side of the handlebar post. Drill all three pieces together to take a pair of ¼-in. stove bolts. Flare the free ends of the bracket to fit snugly over the tandem frame pivot, and drill ⅜-in. holes in the straps to fit the king bolt. Adjust the handlebar so it just clears the front seat and springs. Then drill a ¼-in. hole through the straps and frame hinge clasp for a ¼-in. stove bolt (optional).

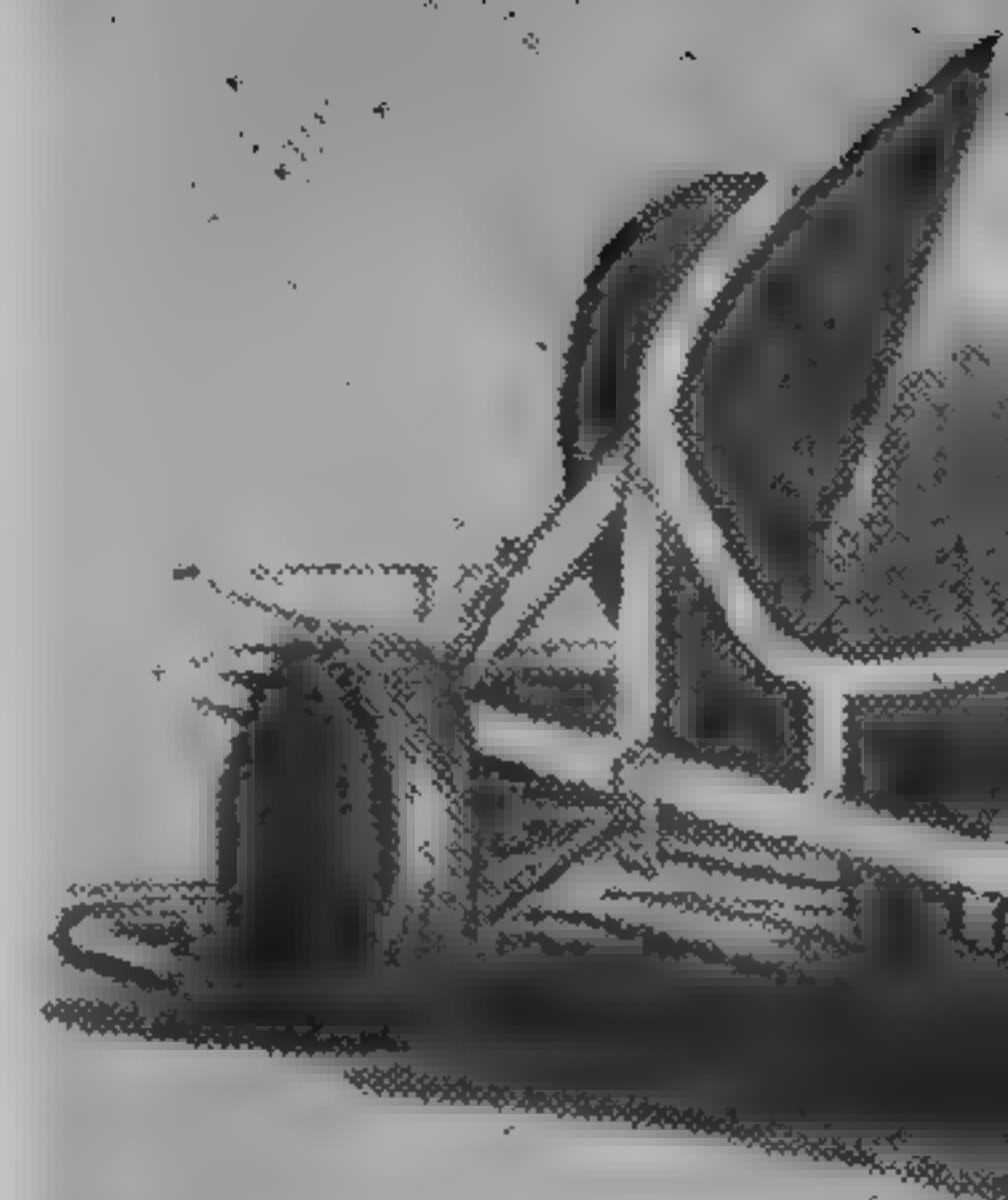
Install the front chain next. Since the standard chain is too short, add length, and be sure the two cranks are in matching positions, so that the riders will be able to synchronize their pedaling. Add the coaster brake, rear chain and all other parts in the ordinary manner, cleaning and greasing all bearings and moving parts as required.

The regular chain guard will work on the rear drive, but for the front chain, you can improvise a guard by bending a straight channel from sheet aluminum, or by using a piece of aluminum edge molding. Fasten the guard with sheet metal brackets.

Because there are only two wheels to carry the weight of two riders, extra tire pressure is required for easy pedaling. If you use balloon tires, they must be in prime condition and be inflated to 30 or 35 pounds. Middleweight tires can safely stand 5 to 10 pounds more pressure than their rating, while lightweight tires in good condition can stand up to 55 pounds.

Riding the tandem is easy for any cyclist. The rear rider should sit relaxed, and lean slightly to the inside of turns, and at first may have to resist a natural impulse to steer with the dummy handlebar. *Be sure to coast around sharp corners*, with riders' feet in a line horizontally, to keep pedals and toes off the pavement. Because of the longer axle span of the tandem, the pedal clearance on corners is more of a problem than on an ordinary bike.

A stand for your tandem is optional. Since there is more length and weight to balance, the ordinary kick stand may not quite do the job. Try to find an old U-shaped rear axle stand, a kind now obsolete. Otherwise, improvise one of metal tubing, or channel iron.



Cart's low center of gravity is a big plus at speed. Sissy bars at both ends of the seat are a nice touch.

AFTER assembling as prescribed in Part S&M), bolt the (J in Fig. 4, Part 1) welded on the axle.

Use a 1/2 in. cap screw on both sides of the block edges on the plates to block up the chassis frame and high enough to clear the under it. Center the front-axle support (3T Fig. 5, Part 1. Check axle king pins are tilted the chassis and then weld to the axle support on

To locate the spot radius-rod supports (the underside of the chassis rails), slide the radius-rods to their support axle first, then, with support axle ends of the radius rods, slide them to the chassis rails. Check that the support axle is positioned at the correct location before welding the radius rods to the chassis rails.

Steering Gear. The consists of a 25 in. length ing arm welded on one welded on the other the steering arm as in rod first. Then make ings as in Fig. 7B and two shaft collars on the bending the $\frac{1}{2}$ in. con (Fig. 7D) work with of conduit and cut to s to position the horiz wheel at right angles welding it to the steer

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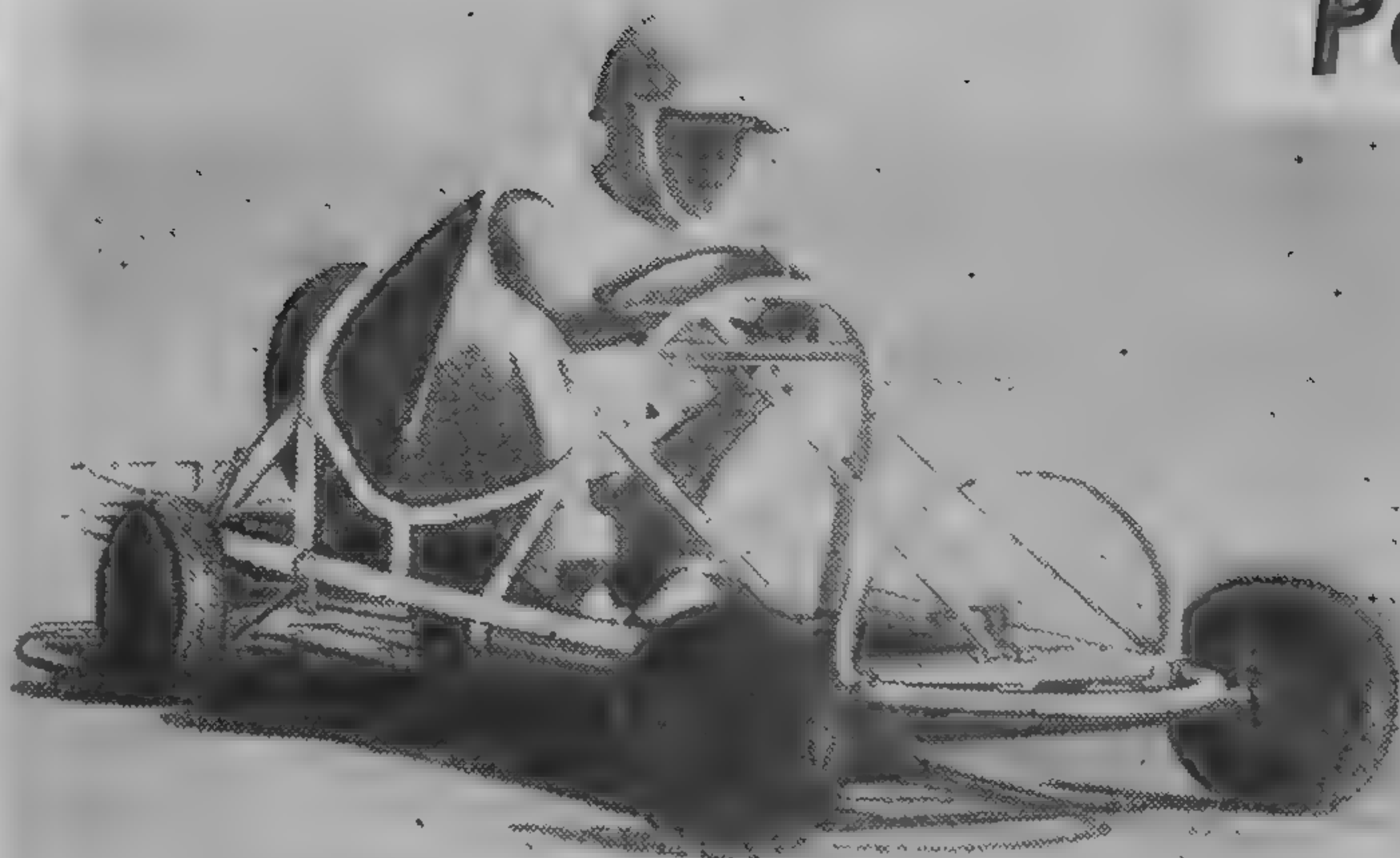
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Cart's low center of gravity makes it possible to take a corner at top speed. Sissy bars at both sides of the seat prevent the youngster from sliding off the seat.

AFTER assembling the front axle as described in Part 1 of this article (Dec. '59, S&M), bolt the two axle anchor plates (J in Fig. 4, Part 1) to the anchor block (H) welded on the axle.

Use a 1/2 in. cap screw and assemble the plates on both sides of the block with the 1/16 in. beveled edges on the plates facing one another. Then block up the chassis frame level with the floor and high enough to slide the assembled axle under it. Center the anchor plates under the front-axle support (3T) as in the front view of Fig. 5, Part 1. Check to see that the top of the axle king pins are tilted 5° toward the rear of the chassis and then weld the axle anchor plates to the axle support on the chassis.

To locate the spot at which to weld the radius-rod supports (Q in Fig. 3, Part 1) to the underside of the chassis frame rails, bolt the radius-rods to their supports welded on the front axle first, then, with supports bolted to the other ends of the radius rods, clamp the supports to the chassis rails. Check to make certain the front axle is positioned at right angles to the chassis before welding the radius-rod supports to the chassis rails.

Steering Gear. The steering rod assembly consists of a 25 in. length of 1/2 in. rod with a steering arm welded on one end and a steering wheel welded on the other end as in Fig. 7A. Make the steering arm as in Fig. 7C and weld it on the rod first. Then make up two steering rod bearings as in Fig. 7B and slide them together with two shaft collars on the rod as in Fig. 7A. When bending the 1/2 in. conduit for the steering wheel (Fig. 7D) work with longer than needed pieces of conduit and cut to size after bending. Be sure to position the horizontal bar of the steering wheel at right angles to the steering arm when welding it to the steering rod.

Parking-Lot Go Cart

Part 2

By ART YOUNGQUIST

Craft Print
Project No. 303

Bolt the bearings of the steering rod assembly to the pan front support and the angle iron on the dash bar as in Figs. 2 and 5 of Part 1, and adjust the two shaft collars on the steering rod against the bearings to keep the steering rod in place. Then insert the

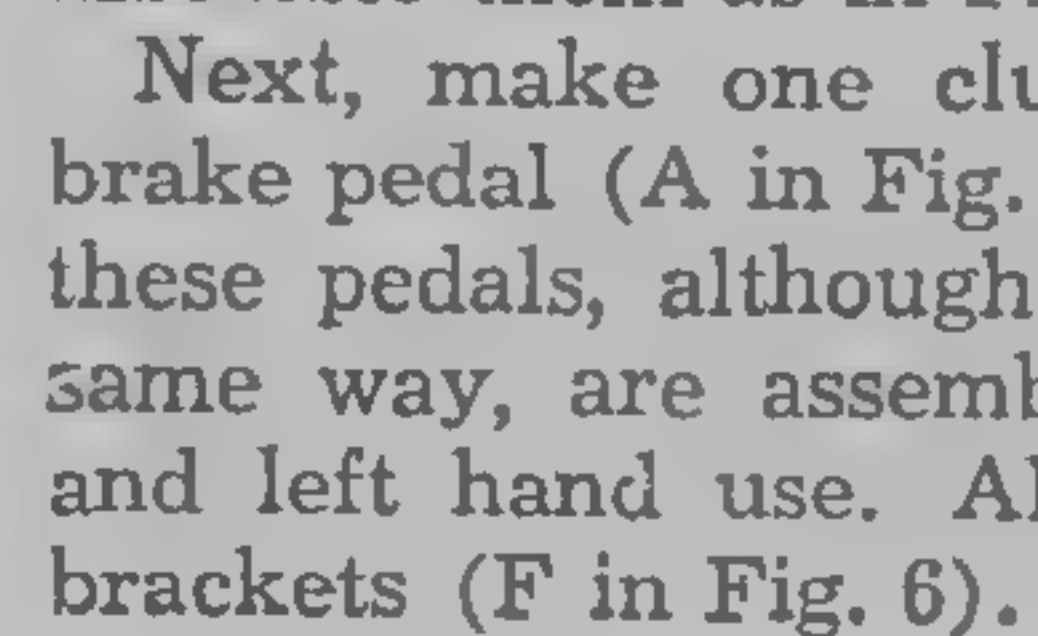
bent end of the steering-lever arm into the 13/32 in. hole in the steering arm and fasten with a slotted nut. Be sure to lock this nut with a cotterpin so there is no chance of its loosening.

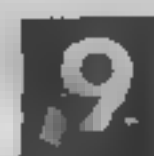
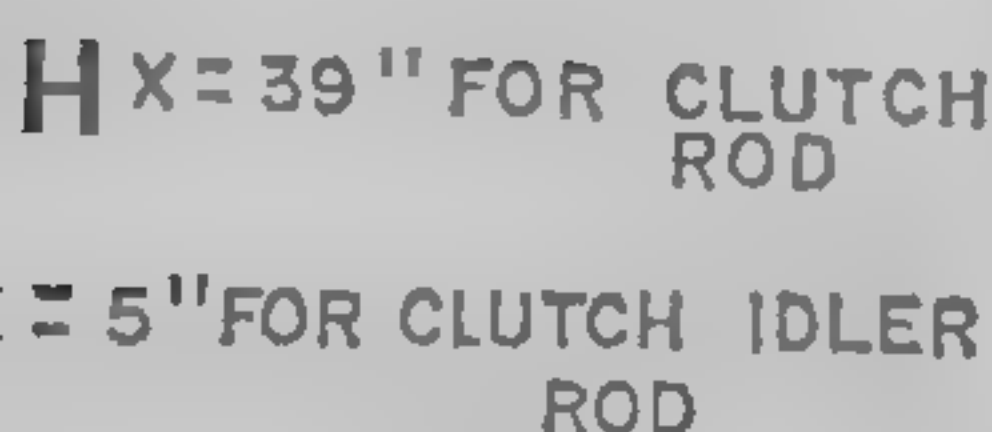
Rear Axle. Since the left rear wheel is used to drive the cart and the right rear wheel for the brake installation, both rear wheels must have a 5 in. dia. pressed-steel, V-belt pulley welded to the wheel hubs. Do not attempt to weld cast iron or die-cast pulleys to the wheels. We used *Maurey* pressed-steel pulleys which are made of heavy enough sheet steel to withstand arc welding. Saw off the pulley hub flush with the side of the pulley with a hacksaw as in Fig. 8.

Remove the tires and tubes and reassemble the wheels so that all of the bolt nuts are on the same side and without lockwashers. Then tack weld the nuts to the wheels. This is important because once the pulley is welded to the wheel you will not be able to get to that side of the wheel. If hex-head bolts were supplied with the wheel and are placed too close to the wheel to use a socket wrench, substitute the hex-head bolts with round or fillister-head bolts with screwdriver slots. Place the lock washers under the bolt heads instead of under the nuts. The pulleys are welded to the same side of the wheel that the nuts are tack welded to so that the tire can be replaced, or removed later, by simply removing the screwdriver-slotted bolts.

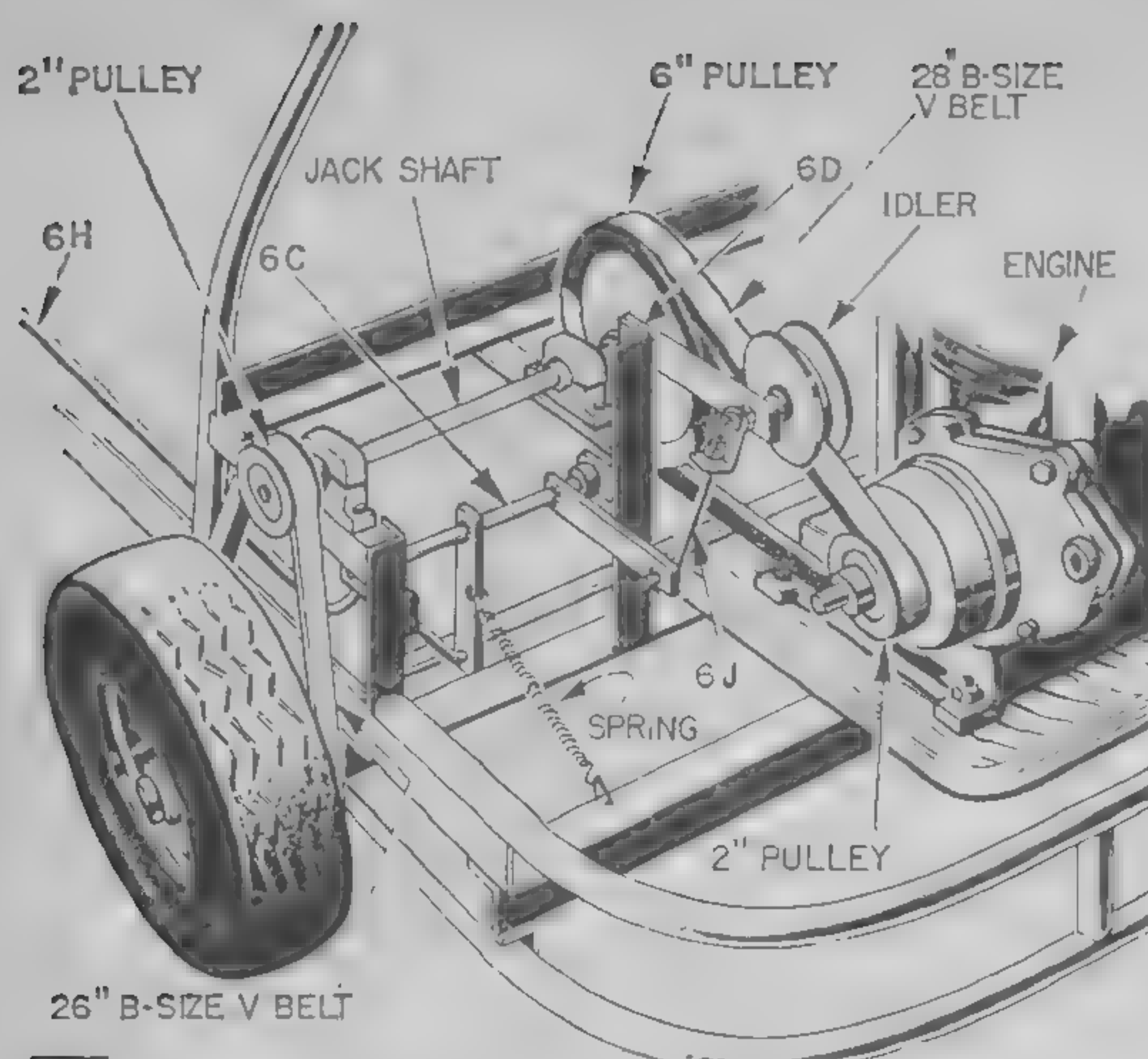
To line up the pulley concentric with the wheel, set the wheel flat on the floor and place the 3/4-in. axle through the wheel bearings. Slide the pulley on the shaft with the sawed-off hub facing the wheel as in Fig. 9. Center the 1 in. bore of the pulley by placing four 1/8-in. dia. nails or lengths of wire between the axle and bore of the pulley. If you happen to have a 3/4-in. I.D. x 1-in. O.D. bushing, use it to center the pulley on

Assemble the jack-shaft pulleys, bearings and collars on a 12 in. length of $\frac{5}{8}$ -in. steel shaft and temporarily clamp it to the jack-shaft supports of the chassis. Then bolt the engine in place on its plywood mounting plate and install the 26-in. V-belt on the wheel and jack shaft pulleys, and the 28-in.





The seat back is a piece of $\frac{1}{4}$ in. plywood padded with foam rubber and covered with plastic material. Back the plywood with a piece of sheet metal as in Fig. 2, Part 1 for a fire wall. To obtain the shape of plywood seat back and sheet metal, make a cardboard pattern by

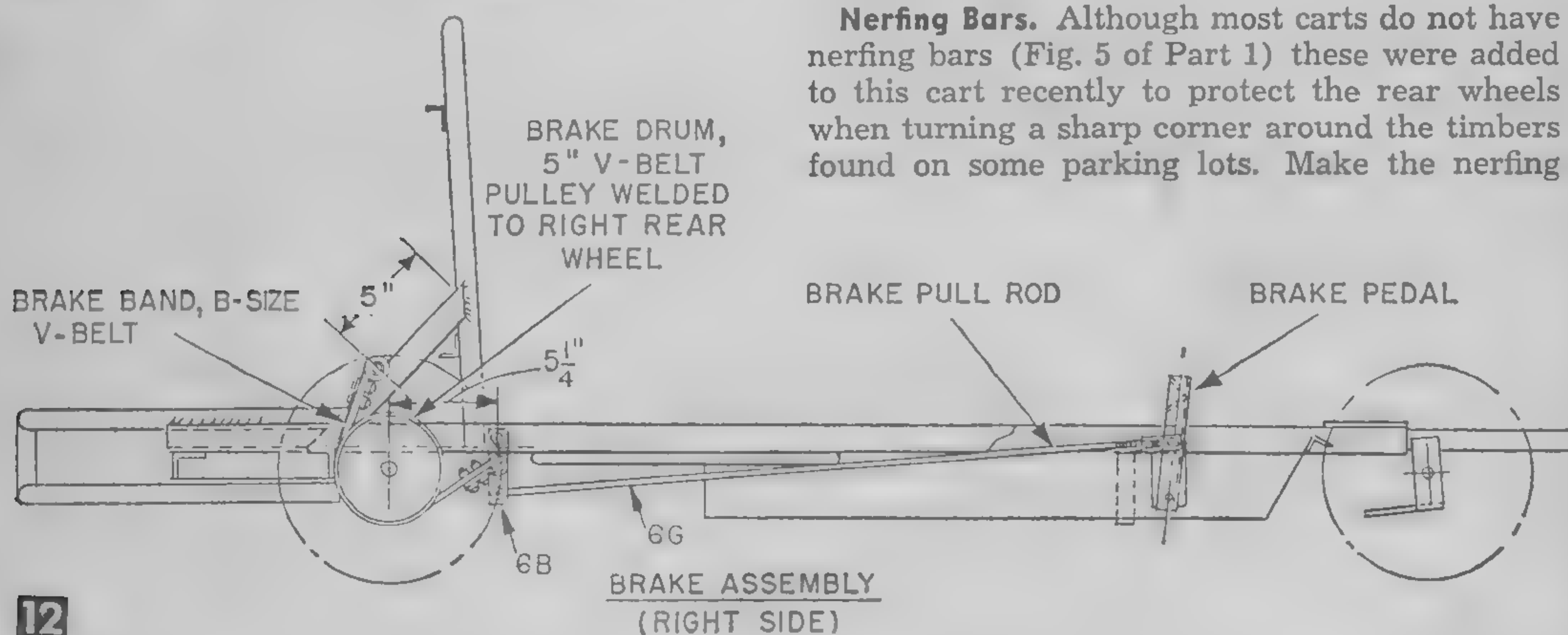


11 CLUTCH AND DRIVE ASSEMBLY

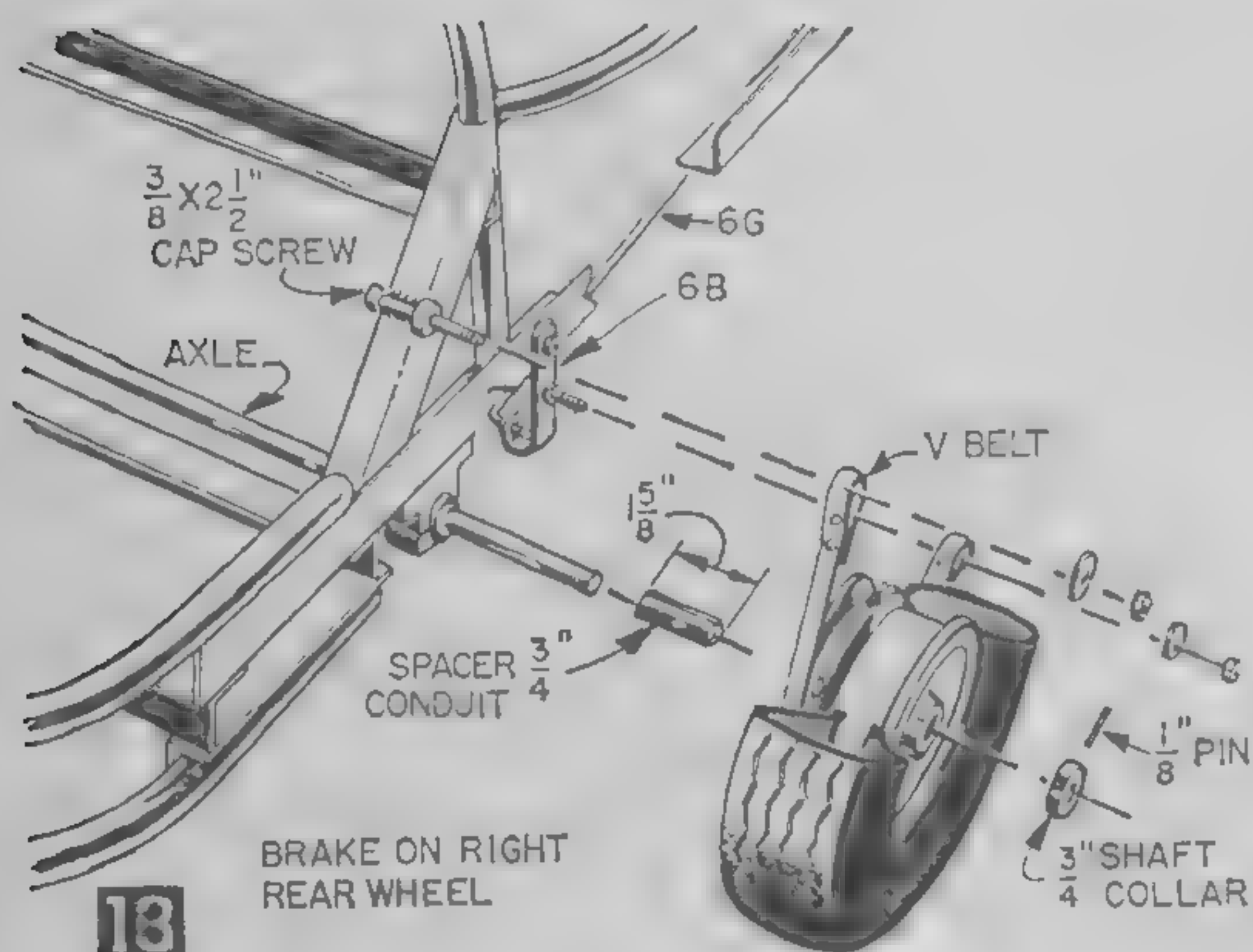
now be determined by measuring from pedal to pull-rod levers. Bend an off-set in the pull-rod as in Fig. 6 to clear the rear axle. Use a 6 in. length of screen-door spring as in Fig. 11, to keep the idler in the "off" position when the clutch pedal is not depressed.

Brake Assembly. When the brake pedal (Fig. 12) is depressed a V-belt is drawn tightly around the pulley on the right rear wheel stopping the cart. First make the brake lever (B in Fig. 6) and bolt it to the chassis rail $5\frac{1}{4}$ in. forward of the rear axle as in Fig. 12. Then cut an old $\frac{5}{8}$ in. car fan belt or new B-size belt to a length that can be wrapped around the pulley on the rear wheel, the $\frac{3}{8}$ in. bolt welded on the chassis and the $\frac{5}{16}$ -in. bolt on the brake lever. Use $\frac{1}{8}$ -in. rh stove bolts or rivets to fasten the ends of the belt to the bolts. Make the brake pull rod (G in Fig. 6) and install it from brake pedal to brake lever. Adjust brake at threaded end of brake rod.

Nerfing Bars. Although most carts do not have nerfing bars (Fig. 5 of Part 1) these were added to this cart recently to protect the rear wheels when turning a sharp corner around the timbers found on some parking lots. Make the nerfing



12



13

assembly forward or backward until the pedals are located for convenient driving. Then clamp the brackets to the rails and drill bolt holes through the rails. Fasten brackets to rails with four $\frac{1}{4}$ x $\frac{3}{4}$ -in. cap screws. Use $\frac{1}{2}$ -in. shaft collars on each side of the pedals to keep them in place on the shaft.

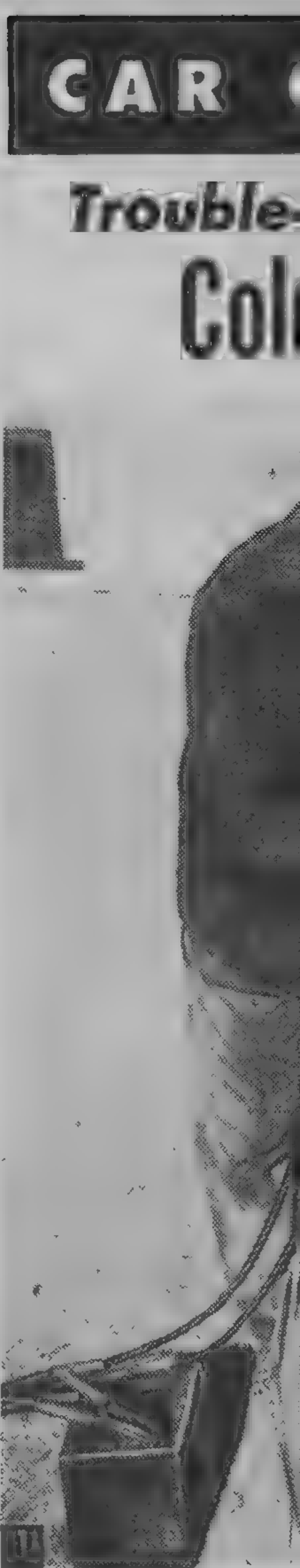
The exact length of the clutch pull rod can

bars from $\frac{3}{8}$ -in. black-iron pipe bent as in Fig. 6 and weld them to the underside of the chassis rails $1\frac{1}{2}$ in. in front of the rear wheels as in Fig. 5 of Part 1.

Your next job, the one you have been waiting for, is teaching your youngster how to drive the cart. As mentioned in Part 1 of this article, this cart is not intended for high-speed adult competition cart racing, but rather for safe carting fun for youngsters. Its strong rugged construction is calculated to make it last for years without you, Dad, having to spend every weekend fixing it to keep it rolling.

Before starting the engine, have your youngster sit in the cart while you push it around the parking lot several times so he can familiarize himself with the steering and brake controls.

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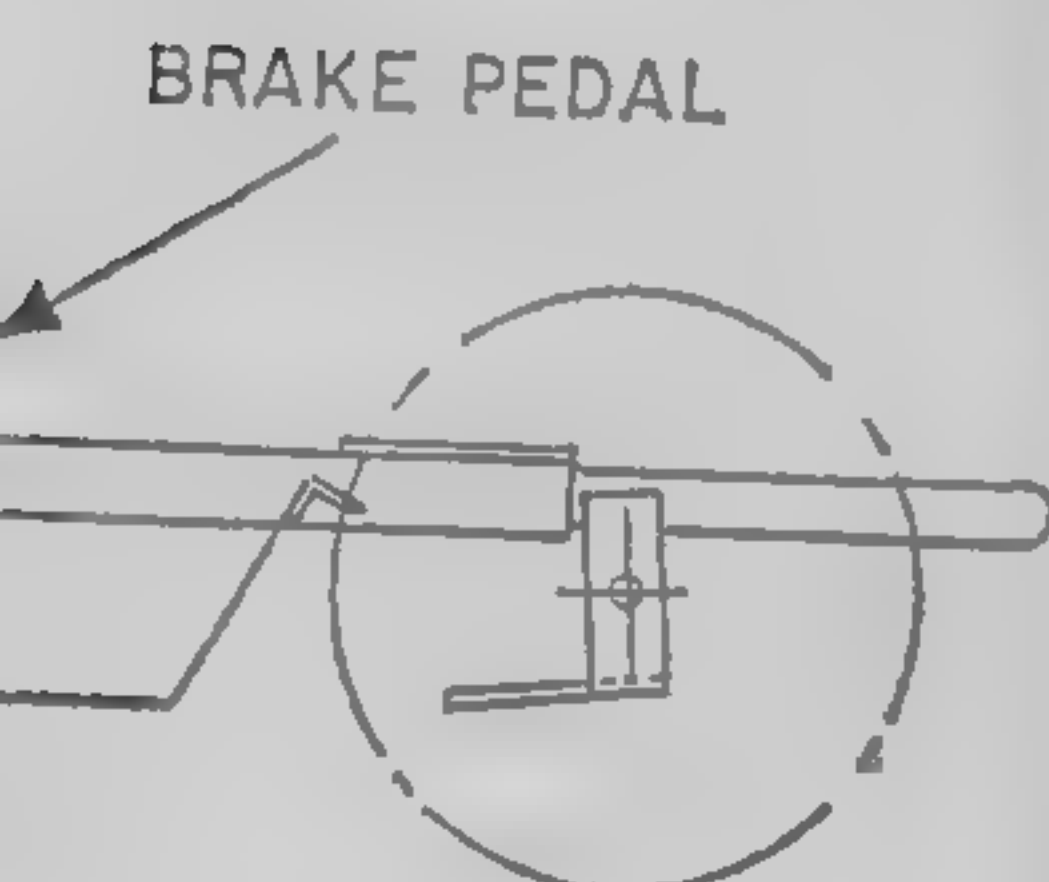
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Slowly depress the

measuring from pedal to an off-set in the pull-rod to the rear axle. Use a 6 in. spring as in Fig. 11, to keep position when the clutch

When the brake pedal (Fig. 1) is drawn tightly around the rear wheel stopping the brake lever (B in Fig. 6) is rail $5\frac{1}{4}$ in. forward of Fig. 12. Then cut an old B-size belt to a length around the pulley on the bolt welded on the chassis at the brake lever. Use rivets to fasten the ends. Make the brake pull rod from it from brake pedal to brake at threaded end of

most carts do not have (part 1) these were added to protect the rear wheels from the timbers around the lots. Make the nerfing



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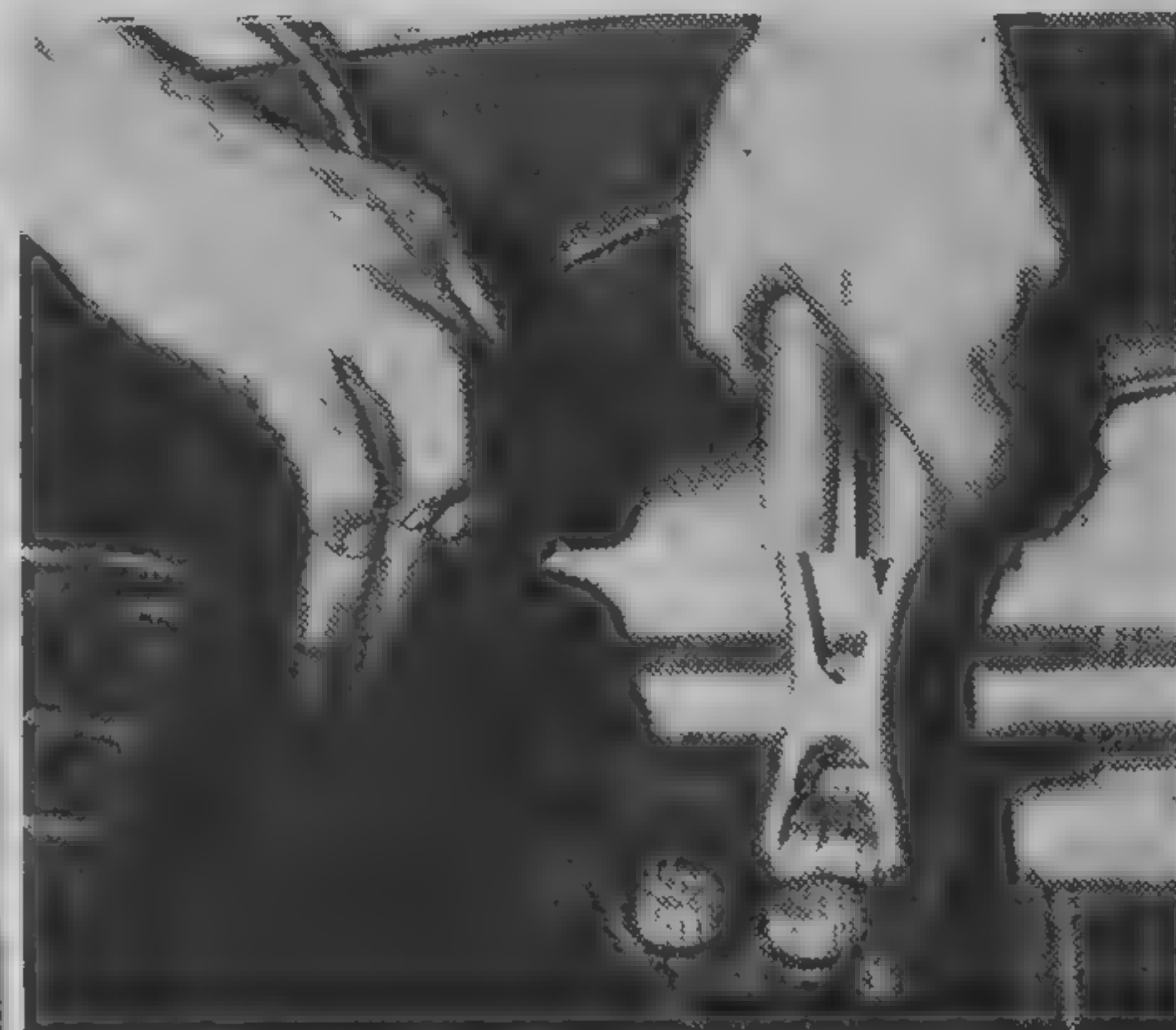
ne, have your young-ou push it around the so he can familiarize and brake controls.

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CAR CLINIC



Trouble-Shooting Cold Weather Starting Problems



A fully charged extra battery (shown in the left foreground) connected to the car battery with booster cables, as in the inset photo and Fig. 2, supplied the needed current to start this car that has a run-down battery.

By FRED BROWN

to the floor. Then, holding the pedal half way to the floor, turn on the ignition switch and hit the starter button for about 5-6 seconds and release it.

If your car is in reasonably good mechanical condition it should start with the first try or at least after two or three such attempts.

Now, assuming the engine starts, hold the accelerator pedal in the half-down position (unless the engine starts racing) so the automatic choke is free to work. But be ready to give the pedal one or two short pumps if it sounds like the engine is gasping for gas. (Your carburetor may still have a "lean" warm-weather setting). Do not, however, frantically pump the accelerator—you will only flood the engine. It's better

to let the engine die, and then attempt to restart it. Fast pumping of the accelerator may also damage the small pump in the carburetor.

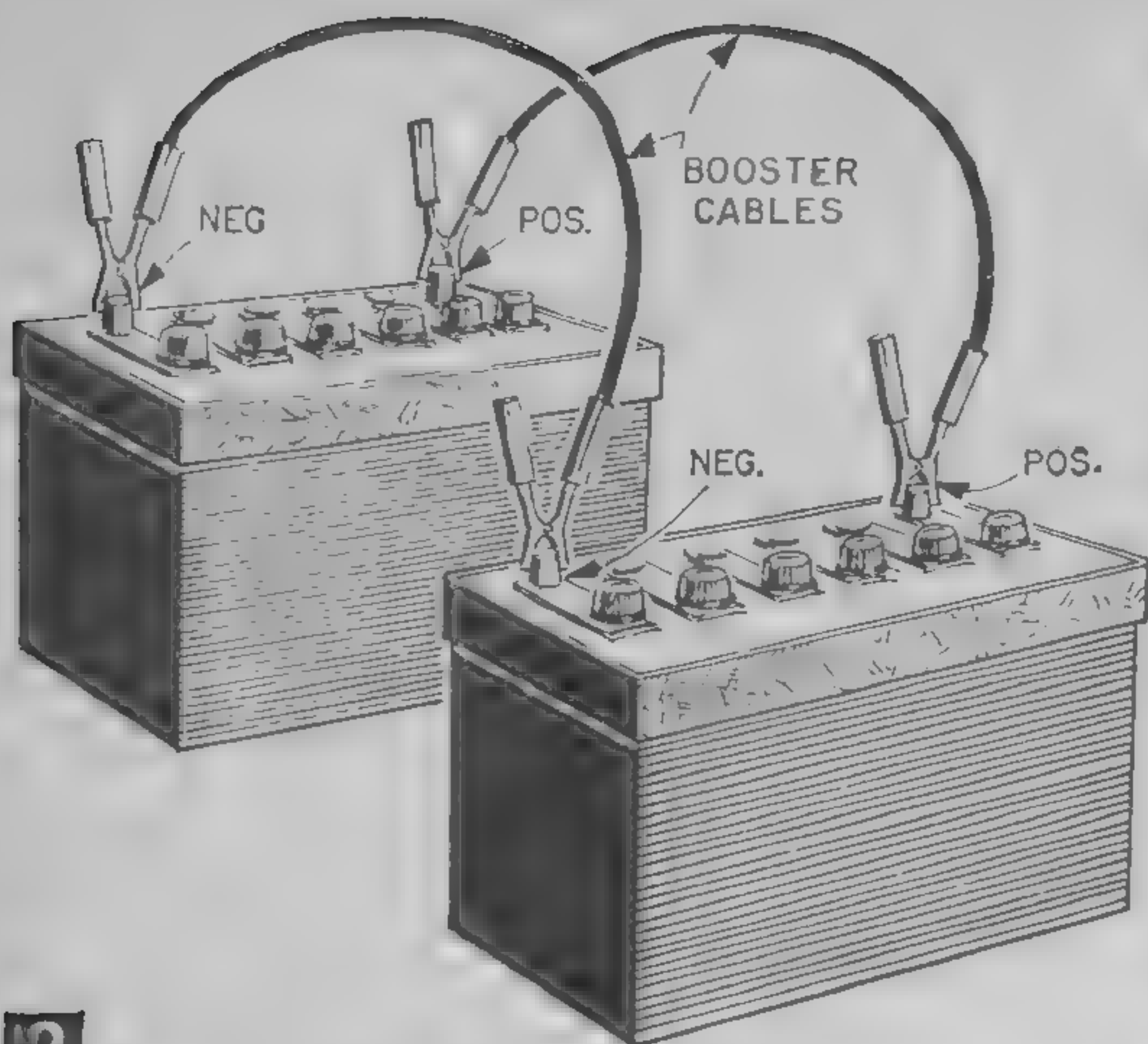
The theory behind this method of starting is this: When you depress the accelerator pedal you actuate a little pump in the carburetor throat (Fig. 3), that is needed for starting. By operating the starter motor only 5-6 seconds, you're not

Why won't the darn jalopy start? Is it a stuck choke valve, flooded carburetor, shorted ignition, run-down battery or an eternal mystery? Here's how a master mechanic advises you to locate and cure the trouble

IN THE many winters I have been called upon to start my customers' cars I have found that 50% of the cold weather starting problem were not the fault of the car as much as they were the faulty method the driver used to start his car.

If you have had trouble starting your car in cold weather, try this method:

Slowly depress the accelerator pedal two times

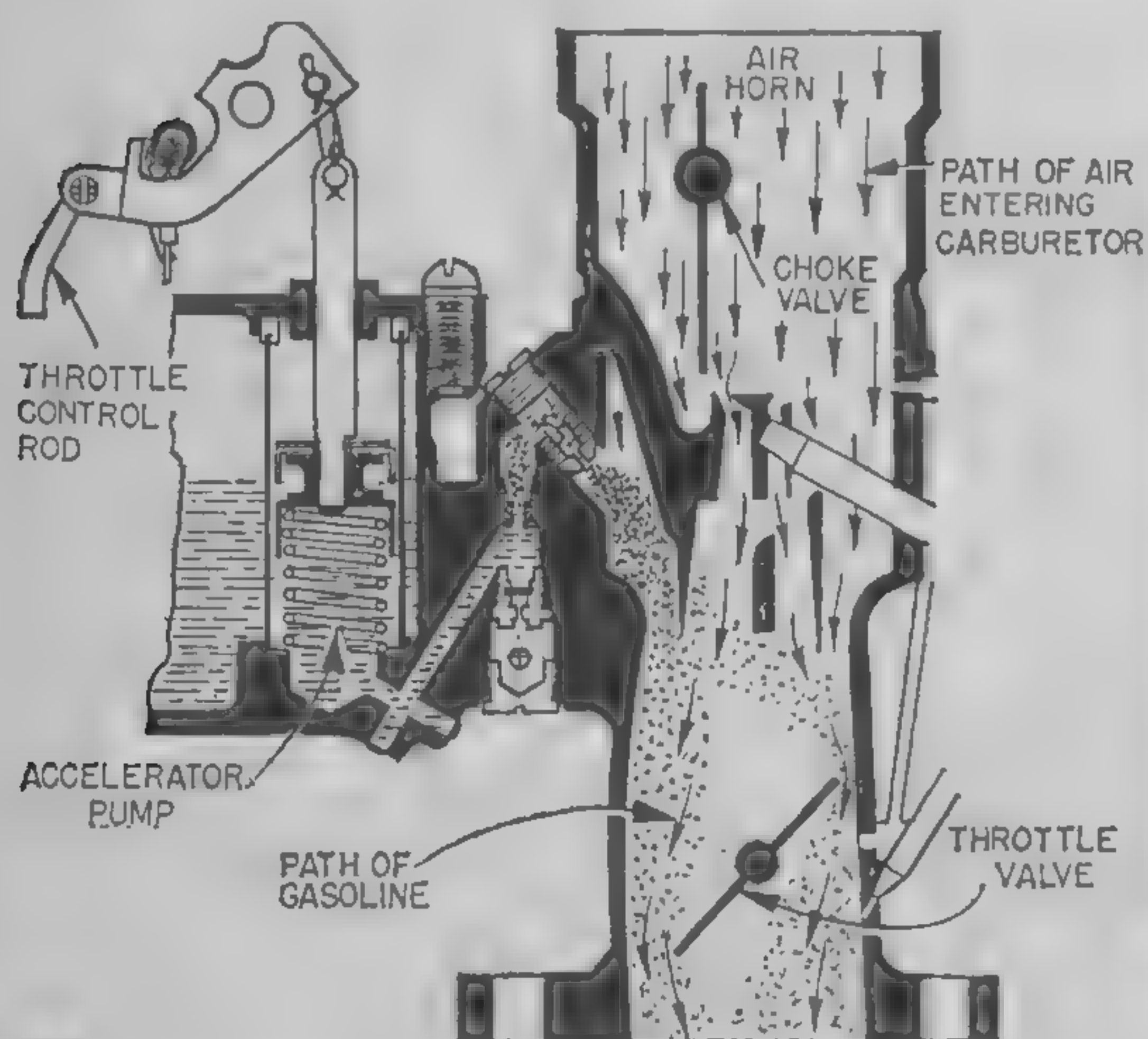


2 BOOSTER BATTERY HOOKUP

only conserving the charge in the battery but also giving the ignition system a chance to use some of the current in the battery. In sub-zero weather the electrical energy in even a fully charged battery is reduced to about one half of what it would have in warm weather.

Suppose, for example, when starting your car the starter motor is using all of the battery current for cranking the engine and the ignition system is getting little or no current. Let's say the moment you release the starter switch, an engine piston is charged with gas and up on its compression stroke. Suddenly it receives enough current to spark the plug and the engine must start or at least fire. Your chances of this happening in two or three tries with the starter are good because of the 3 pistons (on a 6) or 4 pistons (on a V8) that come up for firing at each turn of the engine crankshaft.

Other Starting Aids. On a stick or manual shift car, most of you know that holding the clutch pedal down to the floor to disengage the



3 ACCELERATOR—PUMP SYSTEM IN CARBURETOR



4 To open choke valve, hold throttle-valve rod half open with right hand and lift up lever on fast idle cam with left hand.

transmission will reduce the load on the starter motor. Manual choke controls must be set at closed (pulled out), or nearly closed position when starting, and then gradually moved to the open (pushed in) position as the engine warms up.

Very well, you might say, but what if my car still refuses to start?

Checking the Carburetor Choke. If you have ever called a garage serviceman to start your car, you probably wondered what he did when he lifted the hood; jiggled a few control levers on the carburetor and presto, your car started right off. Automatic choke controls have an annoying habit of sticking, especially when the weather is cold. All the garage man did was push the choke valve lever, opening it.

You can do this yourself—the trick is in knowing which carburetor lever to push. The carburetor



5 To remove air cleaner on a '57 Chevy V-8, take off wing nut and lift cleaner up off carburetor.



6 Sluggish choke valve on moving small lever

retor shown in Fig. 4 on many cars today. valve, pull (or push) back about half way a other hand, lift up on lever. Or you can move shaft as in Fig. 7. If the engine, hold the way down to the floor cranks the engine to It may take half a minute cranking to clear the

Some Chrysler products control on the carburetor valve closed when the When these carburetors way to open the choke are alone, is to remove a screwdriver as in Fig. in your car and crank. Allow the engine to v the screwdriver and re

Since cranking the condition can quickly charge, leaving you li restart the car, make valve works freely dur gish or stuck choke and dirt embedded i choke-valve and walls (Fig. 3).

To remove the gum valve, remove the air vent such as Gumout stores) on the choke the carburetor as in brush saturated with the born deposits. Clean t of the carburetor with oil the choke valve be will only accumulate again interfere with fre



Throttle-valve rod half open
up lever on fast idle cam
at hand.

the load on the starter
controls must be set at
nearly closed position
gradually moved to the
on as the engine warms

say, but what if my car

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1957 Chevy V-8, take off
up off carburetor.



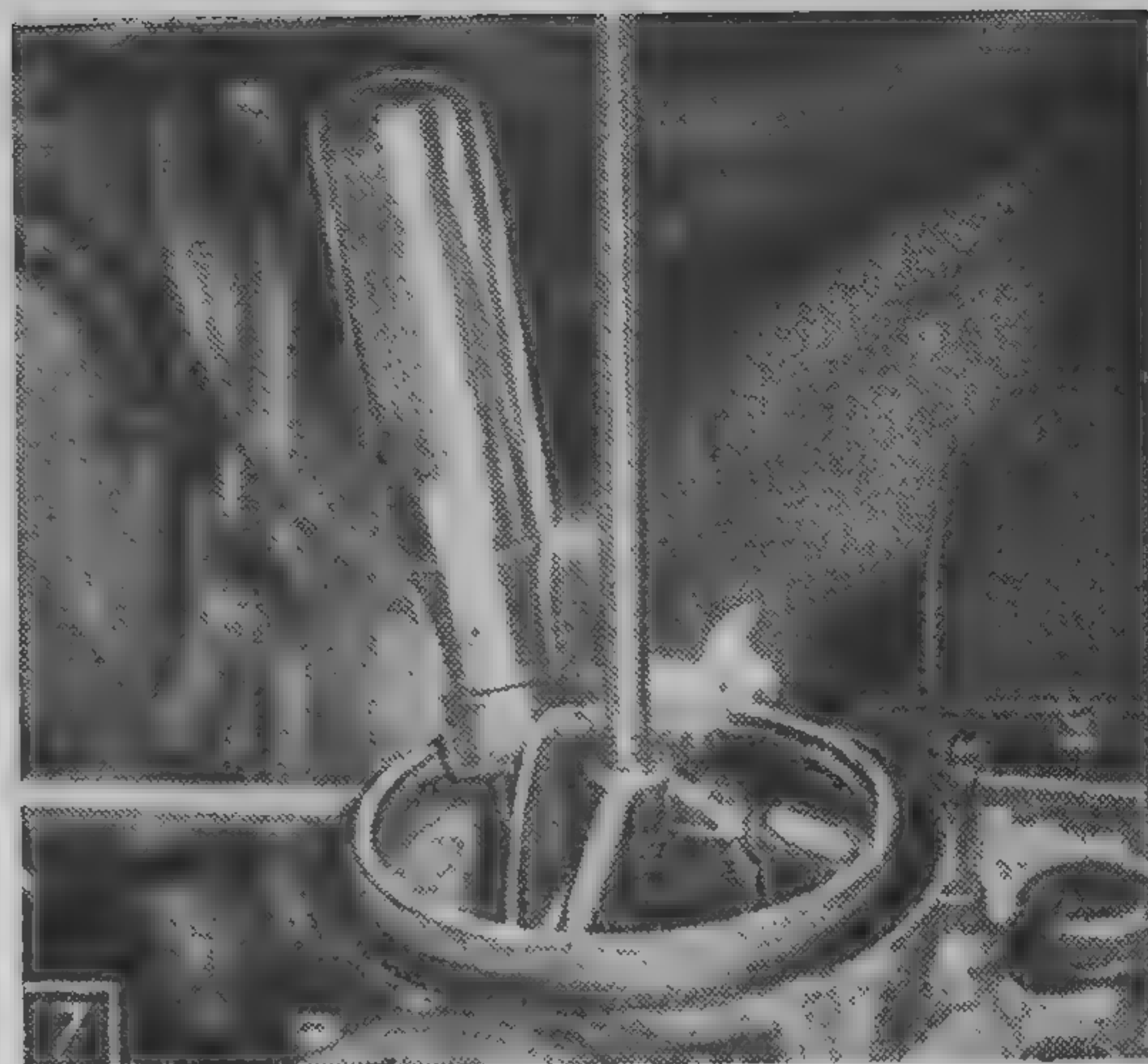
Sluggish choke valve on Chevy 6 can be opened by
moving small lever indicated by arrow above.

retor shown in Fig. 4 is typical of those in use
on many cars today. To open the stuck choke
valve, pull (or push) the accelerator pedal rod
back about half way and, with the finger of your
other hand, lift up on the fast idle, connector-rod
lever. Or you can move the lever on the choke
shaft as in Fig. 7. If the stuck choke valve flooded
the engine, hold the accelerator pedal all the
way down to the floor while the starter motor
cranks the engine to clear it of the excess gas.
It may take half a minute or more of continuous
cranking to clear the engine.

Some Chrysler product cars have an electrical
control on the carburetor that holds the choke
valve closed when the starter motor is operating.
When these carburetors become flooded, the only
way to open the choke and hold it open, if you
are alone, is to remove the air cleaner and insert
a screwdriver as in Fig. 7. You can now get back
in your car and crank the engine until it starts.
Allow the engine to warm up before removing
the screwdriver and replacing the air cleaner.

Since cranking the engine to clear a flooded
condition can quickly drain a cold battery of its
charge, leaving you little or no charge left to
restart the car, make sure the automatic choke
valve works freely during cold weather. A slug-
gish or stuck choke valve is caused by dust
and dirt embedded in gum deposits on the
choke-valve and walls of the carburetor air horn
(Fig. 3).

To remove the gum deposits and free the choke
valve, remove the air cleaner and squirt a sol-
vent such as *Gumout* (available at auto supply
stores) on the choke valve and inside walls of
the carburetor as in Fig. 8. Use a small paint
brush saturated with the solvent to remove stub-
born deposits. Clean the linkage on the outside
of the carburetor with the solvent too. Do not
oil the choke valve bearings or linkage since it
will only accumulate dust and dirt which will
again interfere with free operation of the choke.



Carburetors having an electrically controlled choke
valve can be held open by inserting a screw driver
down into carburetor air intake.

When replacing the air cleaner do not turn
the screw which holds it on the carburetor too
tightly. This may spring the carburetor casting
and cause the choke valve to bind.

Keeping your car battery charged is the func-
tion of your car's charging system.

A good rule-of-thumb check on the ability
of your charging system to keep the battery
charged, is to turn on all the car accessories and



To keep a carburetor choke valve operating freely,
take off air cleaner and squirt a carburetor cleaning
solvent on choke valve and linkage to remove dirt
and gum deposits.



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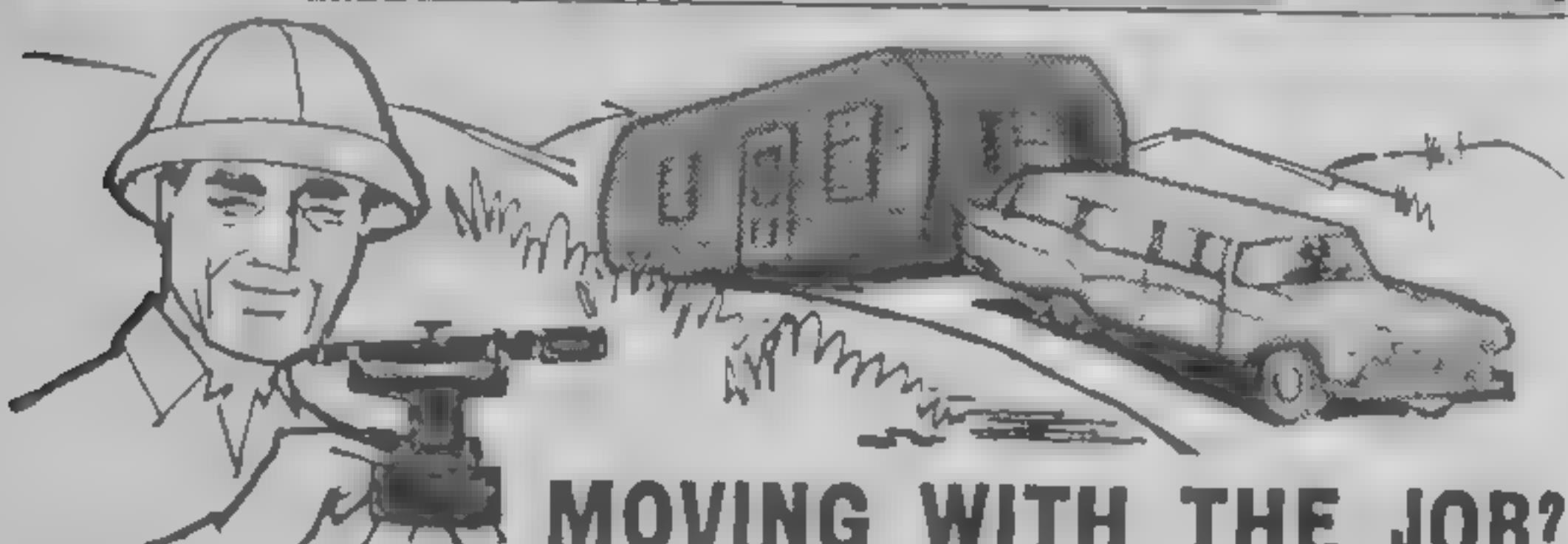
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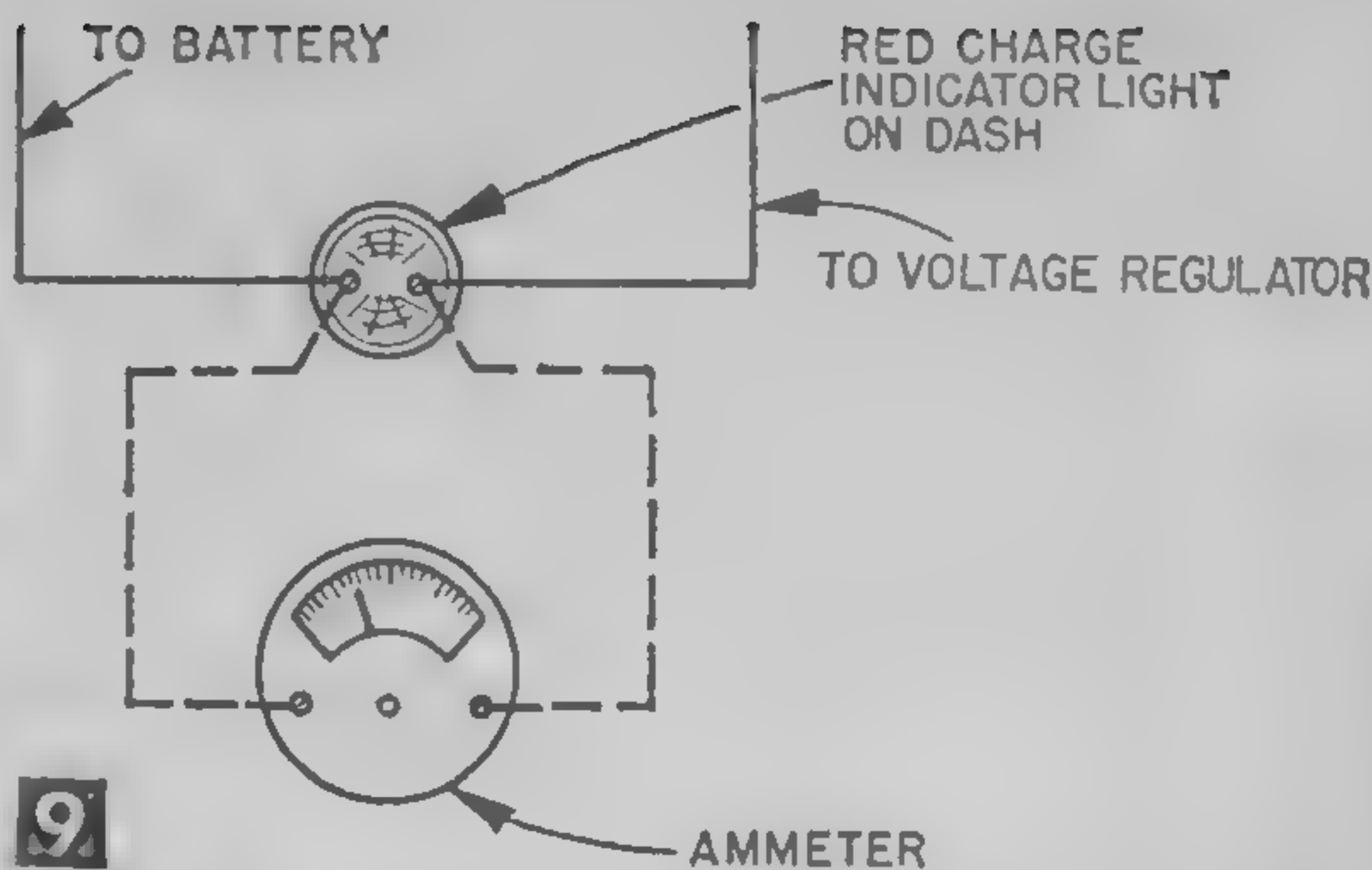
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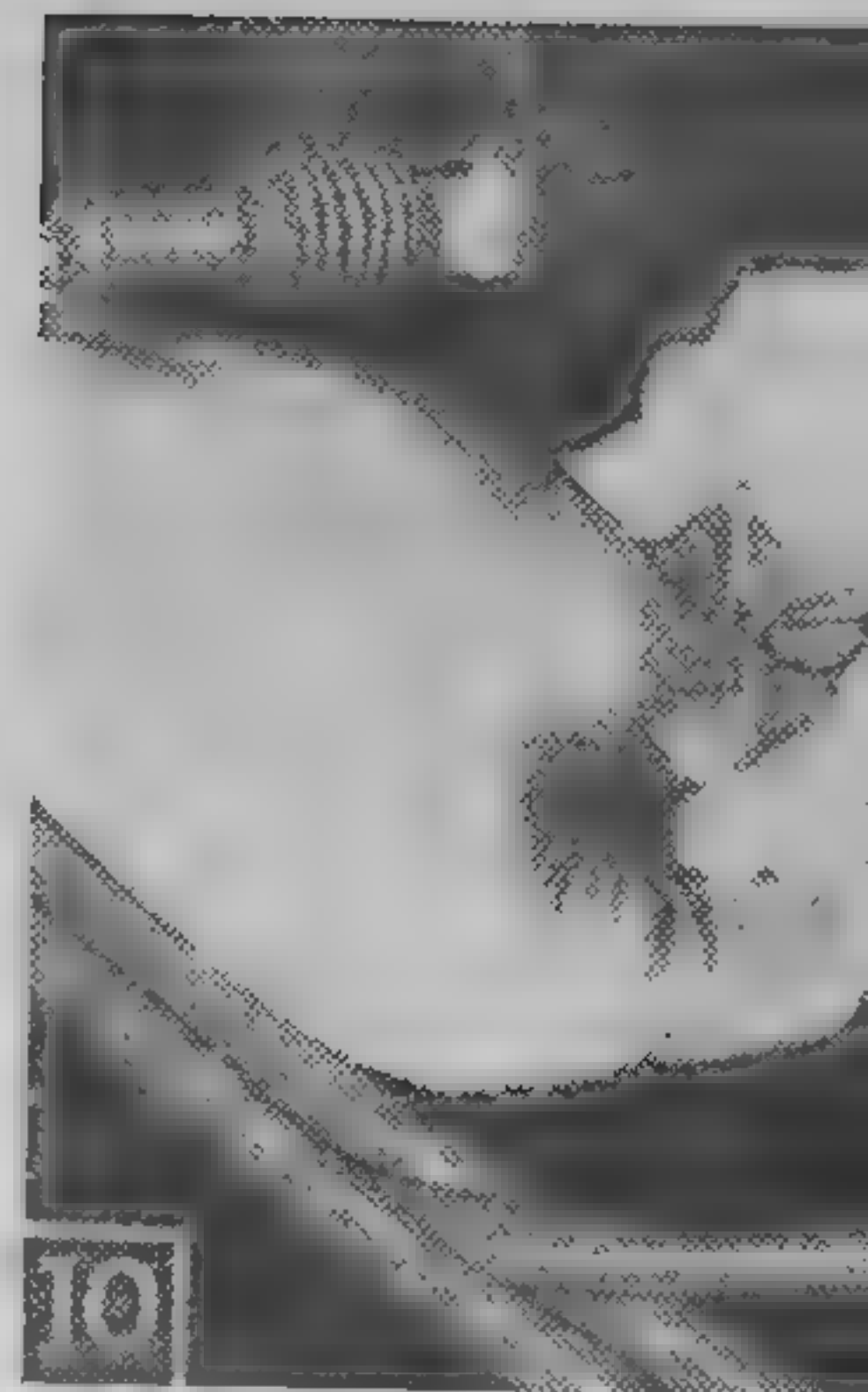
lights while traveling at about 30 mph. If the generator is able to carry this accessory load and register a charge on an ammeter, hooked up to the charge indicator light on the dash as in Fig. 9, your car's charging system is working well. Inexpensive ammeters for this purpose are available from auto supply stores.

If you use your car for driving to work every day and the run is not sufficient for the generator to maintain a charged battery on sub-zero days, your best bet is an inexpensive battery charger. One of these small chargers, costing about \$8, has an automatic shut-off to prevent overcharging the battery. It can be plugged into any 115-volt outlet and left to operate all night.

The battery charger, of course, will not do you much good if you must park out on the street all night and in a parking lot all day. Your next best bet, since few motorists with automatic transmission cars care to push a stalled car to start it, is to have your own set of battery booster cables. (The type that garage servicemen use to get your car started when the battery is low.) With these cables you can "borrow" current from another car battery without removing it from the car. You merely fasten the large spring-type clamps on the ends of the cables of the battery terminals in each car. Be sure to connect the positive terminal on one battery to the positive terminal on the other battery and negative terminal to negative terminal as in Fig. 2. The cable clamps are color coded for identification.

If you are not sure which battery terminal is positive and which negative, first fasten both cables to the terminals on one battery. Then fasten one cable clamp to any terminal on the second battery, and lightly touch the other cable clamp to the remaining terminal. If you get a spark, the hookup is wrong and you have to switch the cable clamps.

Many motorists living in the northern states where a sub-zero cold snap can last for weeks, purchase an extra used car battery for emergency use. This battery is kept fully charged in a warm basement. If their car does not start with the car battery after a few tries, the extra battery, with a full charge because it is warm, is brought out and hooked up to the car battery with booster cables as in Fig. 1, and used to start the car. The extra battery is then placed in the car trunk and again used if the car will not start



Wiping porcelain of spark plug to remove moisture which

after being parked in. **Ignition Failure.** If your car won't start outside in a driving snow storm, it could be due to a frozen distributor cap or spark plugs because of ice. To prevent this, pull the wires and the plugs one at a time and dry them with cloth. The distributor cap dry if there is any indication of moisture. If the cap is worn or cracked.

To prevent recurrence, spray the plugs, wires and distributor with a waterproof seal such as **Ignition Guard**. Having the ignition system sealed against battery current to operate the ignition system, and the car working properly, a weather starting problem.

Applying Gasket Cement

• When the cap of a hole is badly stuck, try using up the contents. Use gasket cement, push a plug into the tube and let the cement

CUT OFF TUBE END



GASKET CEMENT

hole will seal itself. If the surface to cover, such as a hole, use tin snips to cut the cement comes out in a plug. The open end of the tube of cement will seal itself. TIDD.

RED CHARGE
INDICATOR LIGHT
ON DASH
TO VOLTAGE REGULATOR

AMMETER

about 30 mph. If the
this accessory load and
ammeter, hooked up to
on the dash as in Fig. 9,
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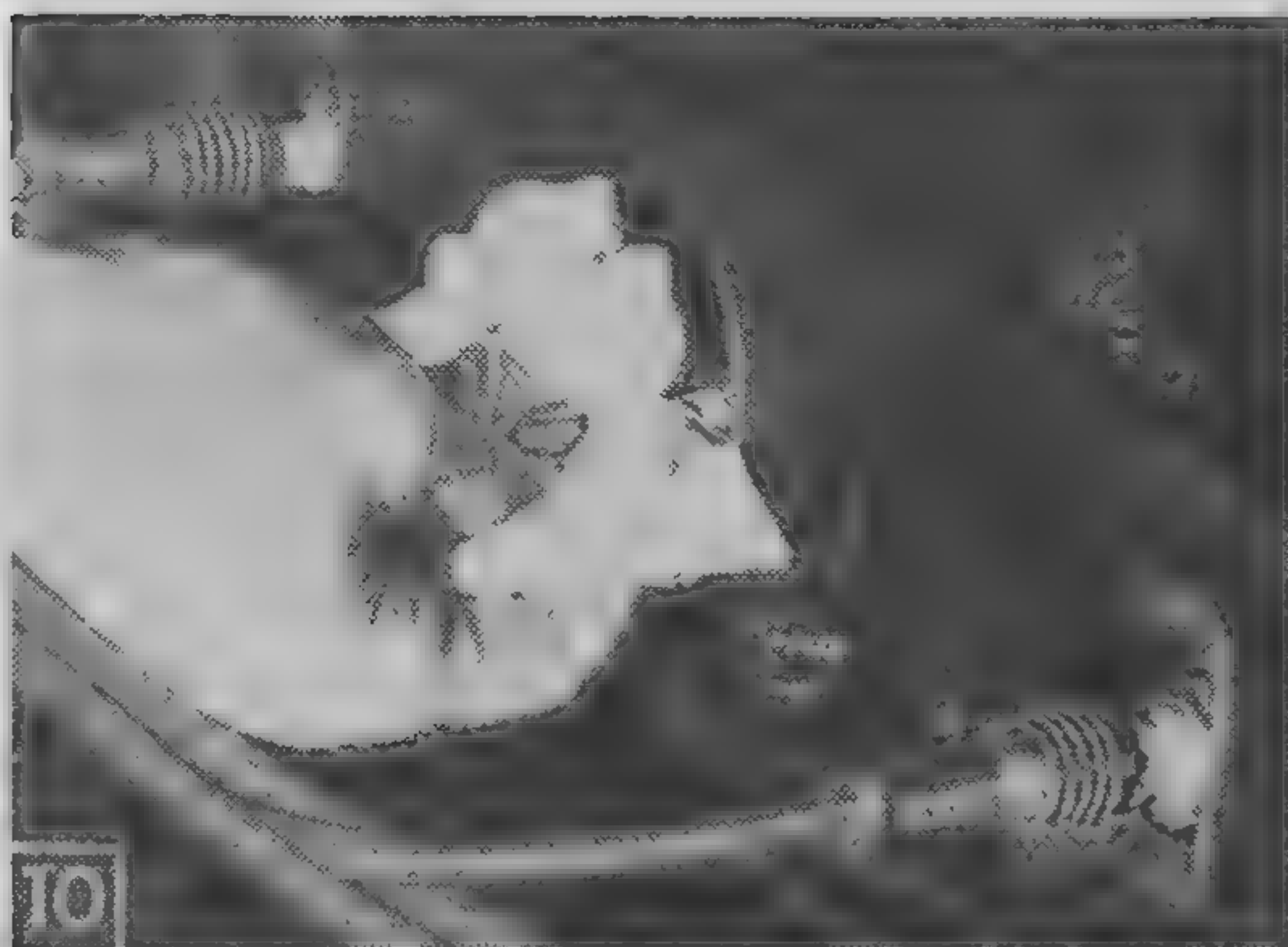
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he car will not start

NCE AND MECHANICS



Wiping porcelain of sparkplugs dry with a cloth to remove moisture which caused plugs to short out.

after being parked in a lot all day.

Ignition Failure. If your car has been parked outside in a driving snow or sleet storm, failure to start could be due to grounding of the ignition current because of ice and snow or moisture on the distributor cap or sparkplugs. If you suspect this, pull the wires and protecting rubber caps off the plugs one at a time and wipe the porcelain of the plugs dry with cloth as in Fig. 10. Also wipe the distributor cap dry, and the sparkplug wires if there is any indication that the insulation is worn or cracked.

To prevent recurrence of this type of trouble, spray the plugs, wires and distributor cap with a waterproof seal such as Nichoff Ignition Seal.

Having the ignition system waterproof, enough battery current to operate the starter motor and ignition system, and the automatic choke control working properly, a good 90% of your cold-weather starting problems will be licked.

Applying Gasket Cement

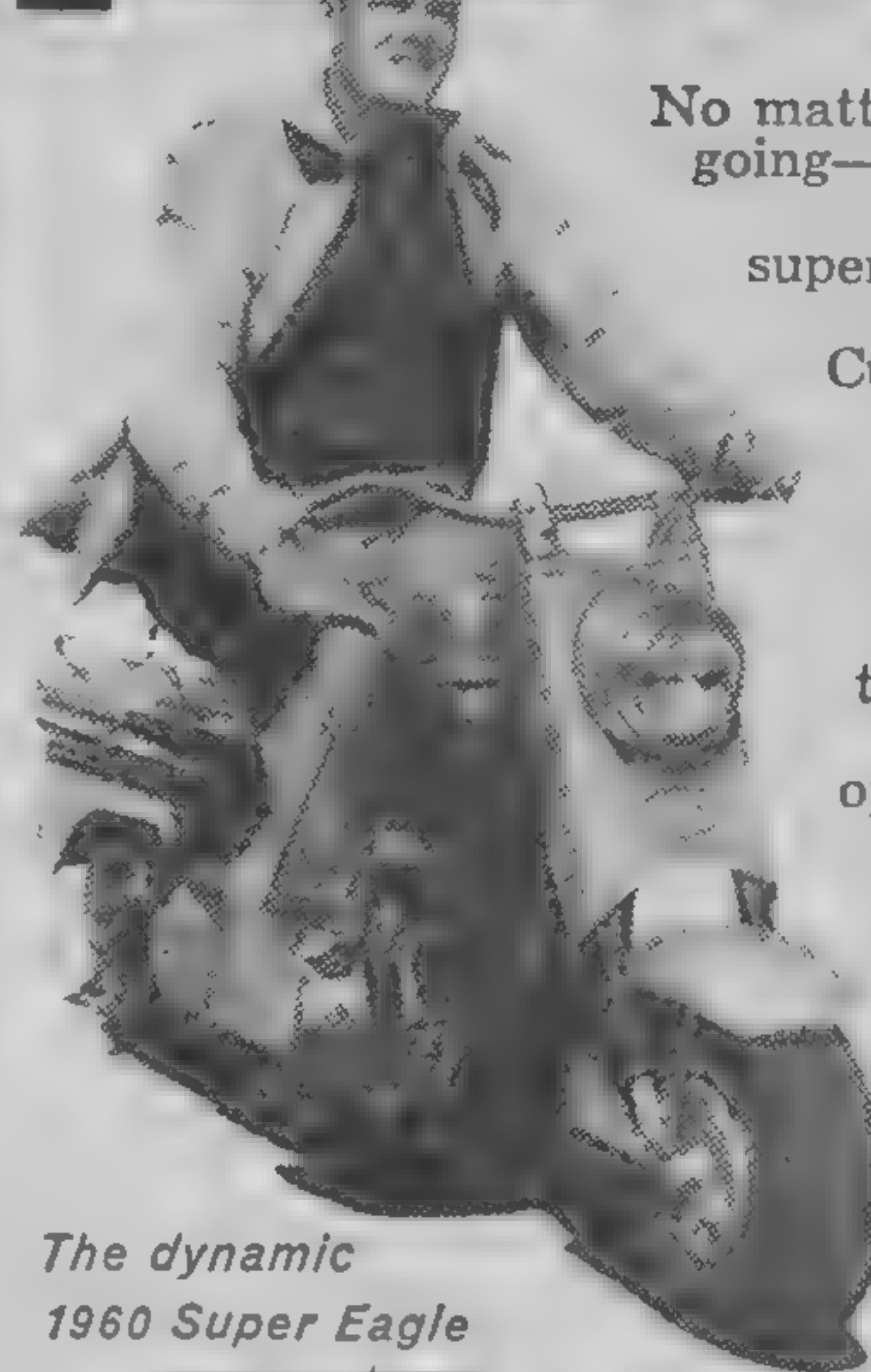
- When the cap of a half-full tube of gasket cement is badly stuck, try these two methods for using up the contents. If you need just a little gasket cement, push a pin through the bottom of the tube and let the cement "back out." The pin



hole will seal itself. If you have a fairly large surface to cover, such as a cylinder head gasket, use tin snips to cut the end from the tube so the cement comes out in a thin ribbon. Fold the open end of the tube over to reseal it.—M.A. TIDD.

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With it, you no longer have to call on your wife or a neighbor to help hold the work, or else run the wobbly risk of tackling the job alone.

I have found it easy to trim as little as 1/2-inch from the long side of a 4 x 8-ft. panel, using this stand. And simply turning the stand upside down, as in Fig. 2, works well in providing supplementary roller support on certain jobs.

You can make the support stand either fixed (as in Fig. 3) or adjustable (as in Fig. 4). For either design, the casters you use *must* be of a good, ball bearing type which will turn freely and rotate smoothly. To make sure you allow the correct height for the casters, temporarily set a

caster in a piece of scrap wood. Then measure from the surface of the wood to the bottom of the wheel.

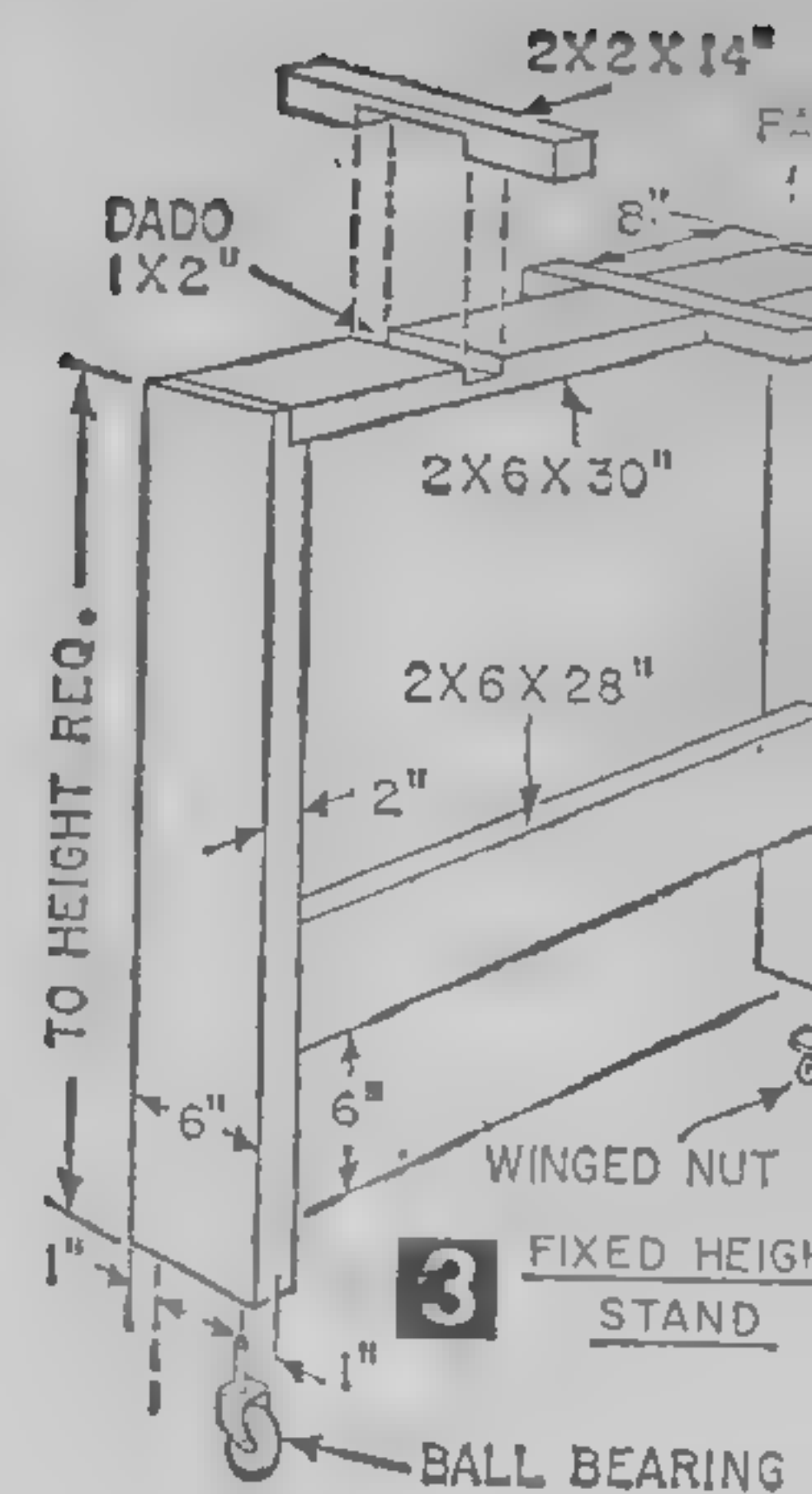
After parts are cut to size according to dimensions shown in Fig. 3 or Fig. 4, you can assemble them with glue and nails. You can use a router bit to make the slots in the adjustable stand, or drill 3/8-in. holes at each end of the slot, and then drill overlapping holes between. Then clean out slot by moving work back and forth as drill is turning. Or use a hand file.

Cabinet Stand with Pivot Jig. Figure 5 shows you another support stand design. This one incorporates a pivot jig you'll find useful when cutting and sanding large circular pieces.

Casters may also be added to this design, as in Fig. 6, to provide support when you are sawing wide panels. Note the perforated Masonite side panels—handy for storing tools. You can also increase the stand's usefulness by adding a bottom and hinging one of its end panels to create an extra storage cabinet.

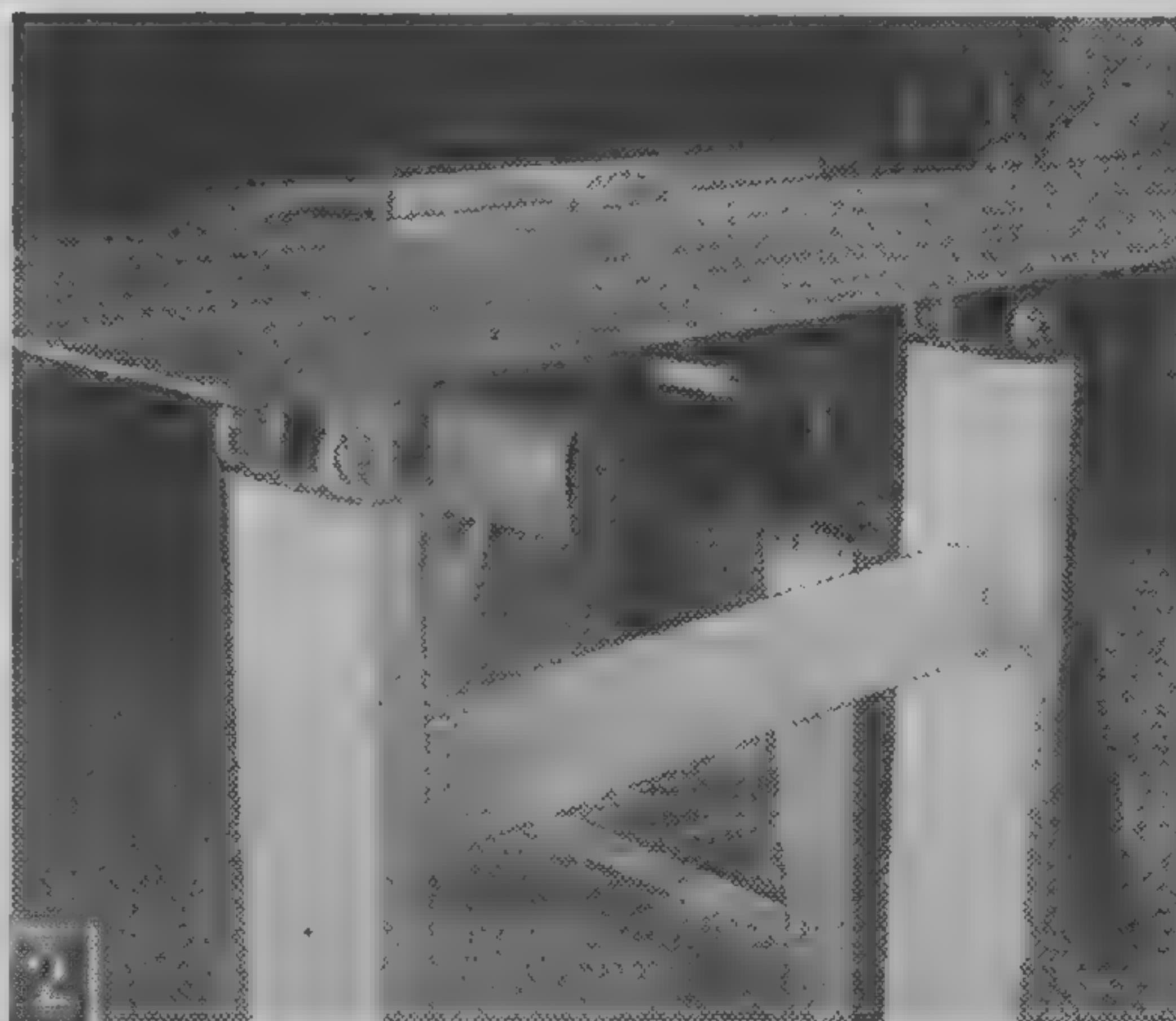
The leg dimensions shown in Fig. 7 are deliberately oversize. Cut them to the full length and, when finished, trim off the bottom of the legs to the exact size you require. Remember, though, that the extra length belongs at the bottom, not the top.

Note grooves cut in the legs and



horizontal cross braced perforated Masonite side panels temporarily assembling the Masonite panels with Masonite panels with corrugated fasteners. Together with the cross-braced and rabbet the end panels and attach them with nails.

To make sure holder is correctly on the cabinet hole through the hold exactly on top of cabinet place (driving nails from top). The hole drilled is your guide for drilling

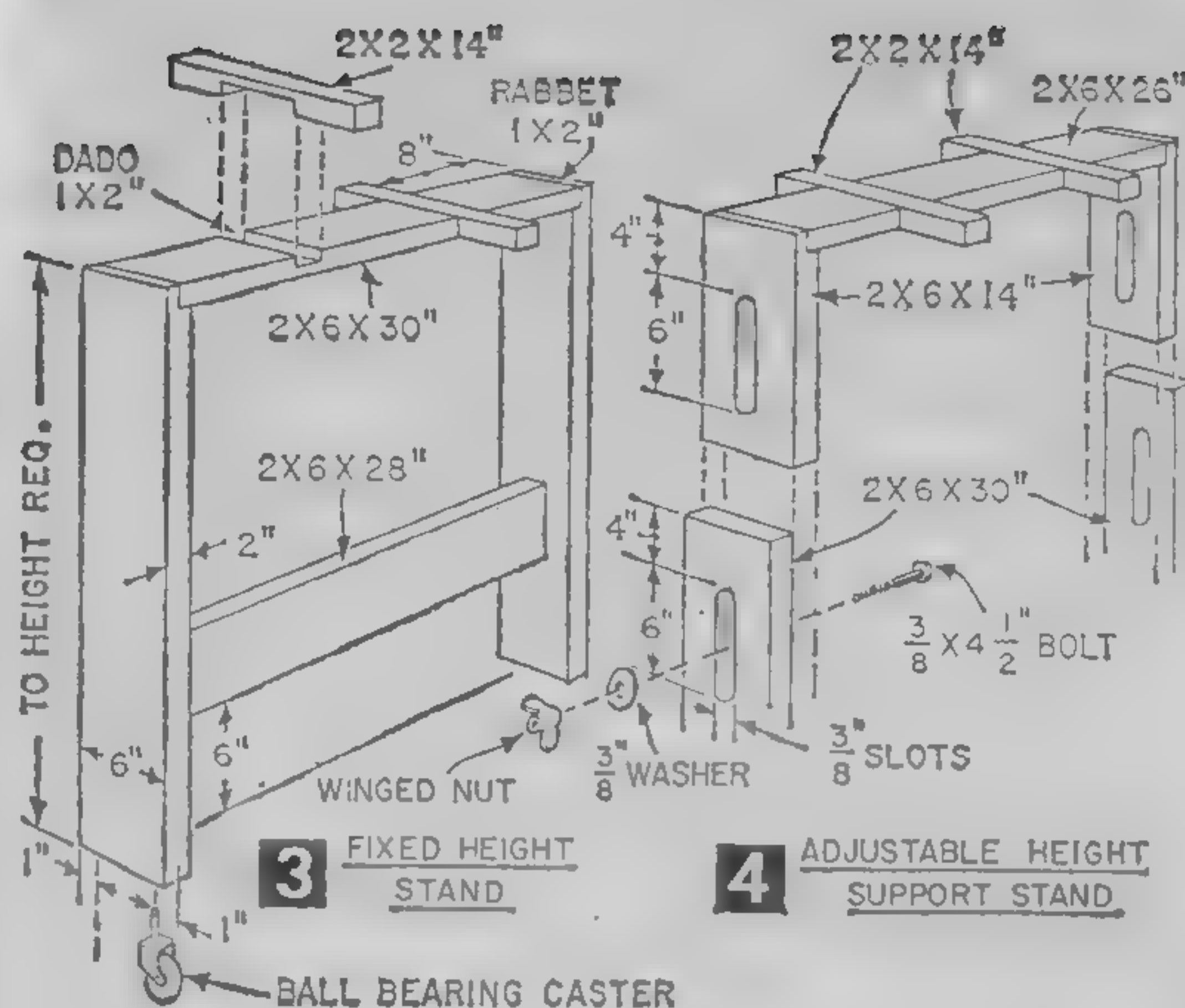


Turned upside down, same stand provides two or four casters which help support work.



Casters may be added to

stand provides two or
p support work.



Adjustable locking pivot rod eases job of circular cutting or sanding.

horizontal cross braces, to accommodate perforated Masonite sides. Cut the Masonite after temporarily assembling the frame pieces, so that the Masonite panels will fit correctly. Then assemble leg and side cross-brace frame pieces, with Masonite panels in place, using glue and corrugated fasteners. Next, assemble sides together with the cross-brace end frames. Cut out and rabbet the end panels along all four edges, and attach them with glue and 1-in. finishing nails.

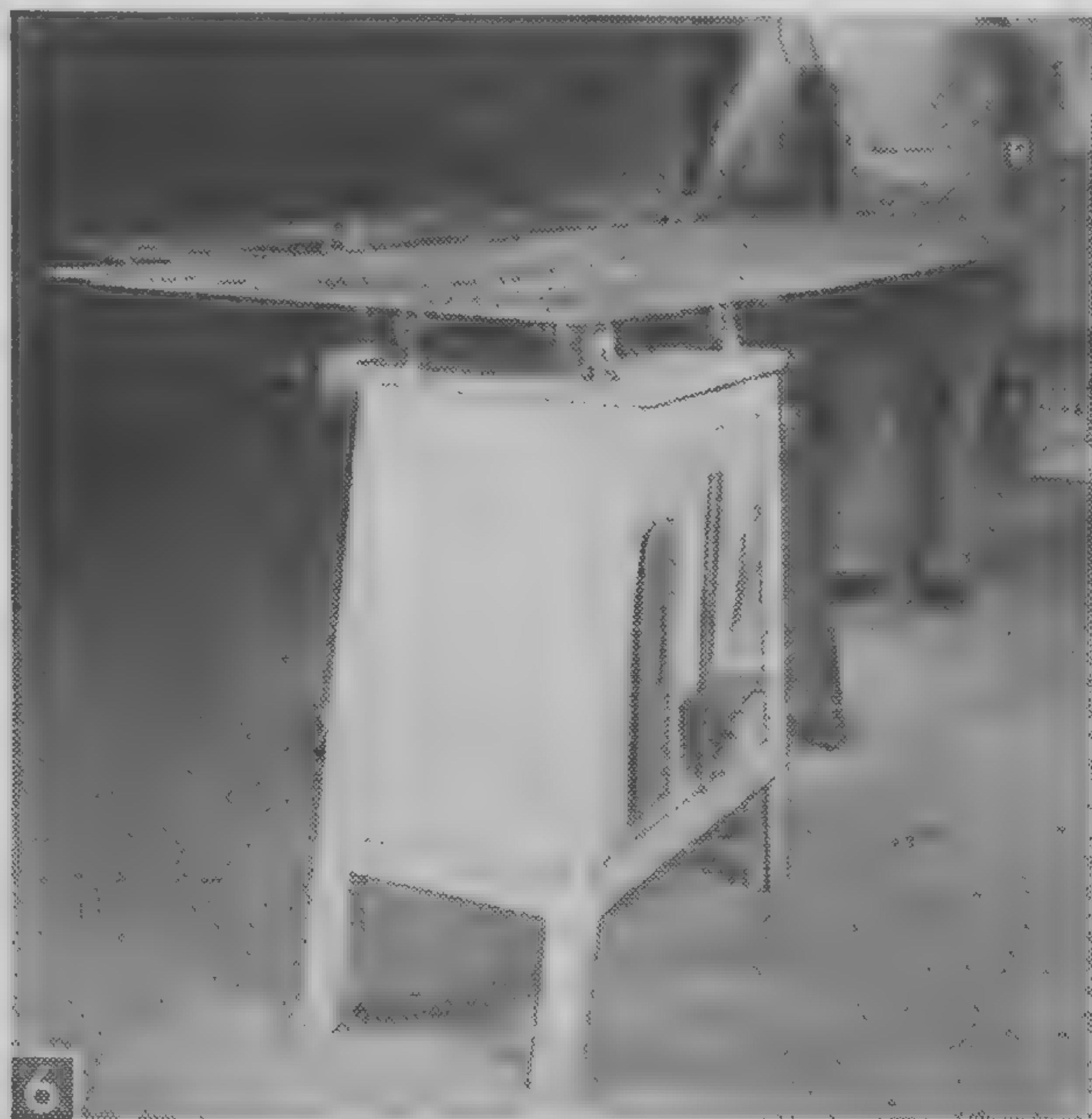
To make sure holder for pivot rod is mounted correctly on the cabinet top (Fig. 7), drill the hole through the holder, then center holder exactly on top of cabinet and glue and nail it in place (driving nails from the underside into the top). The hole drilled in the holder then becomes your guide for drilling a matching hole through

the cabinet top.

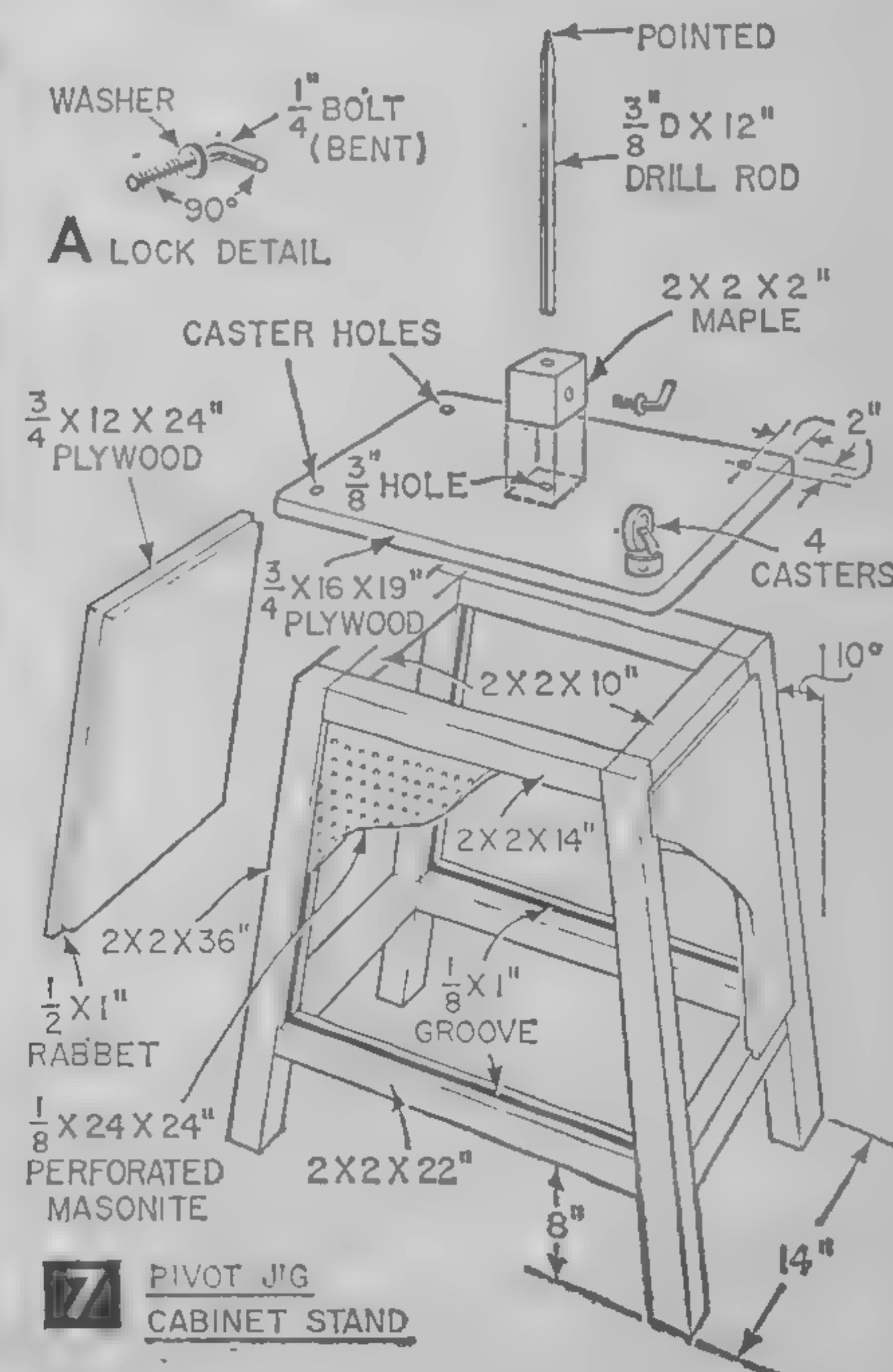
The lock screw hole in the block will have to be tapped to take a $\frac{1}{4}$ in. bolt which is turned to secure the pivot drill rod. Point the top of the rod by grinding or sanding.

Nail the top in place. Then drill the holes for the casters. The lock (A in Fig. 7), is a bolt bent 90° just beyond the threaded portion. You can secure a washer at that point by first peening the washer around the hole to make it smaller, and then forcing it onto the bolt before it is bent. Remove the bolt head by hack-sawing.

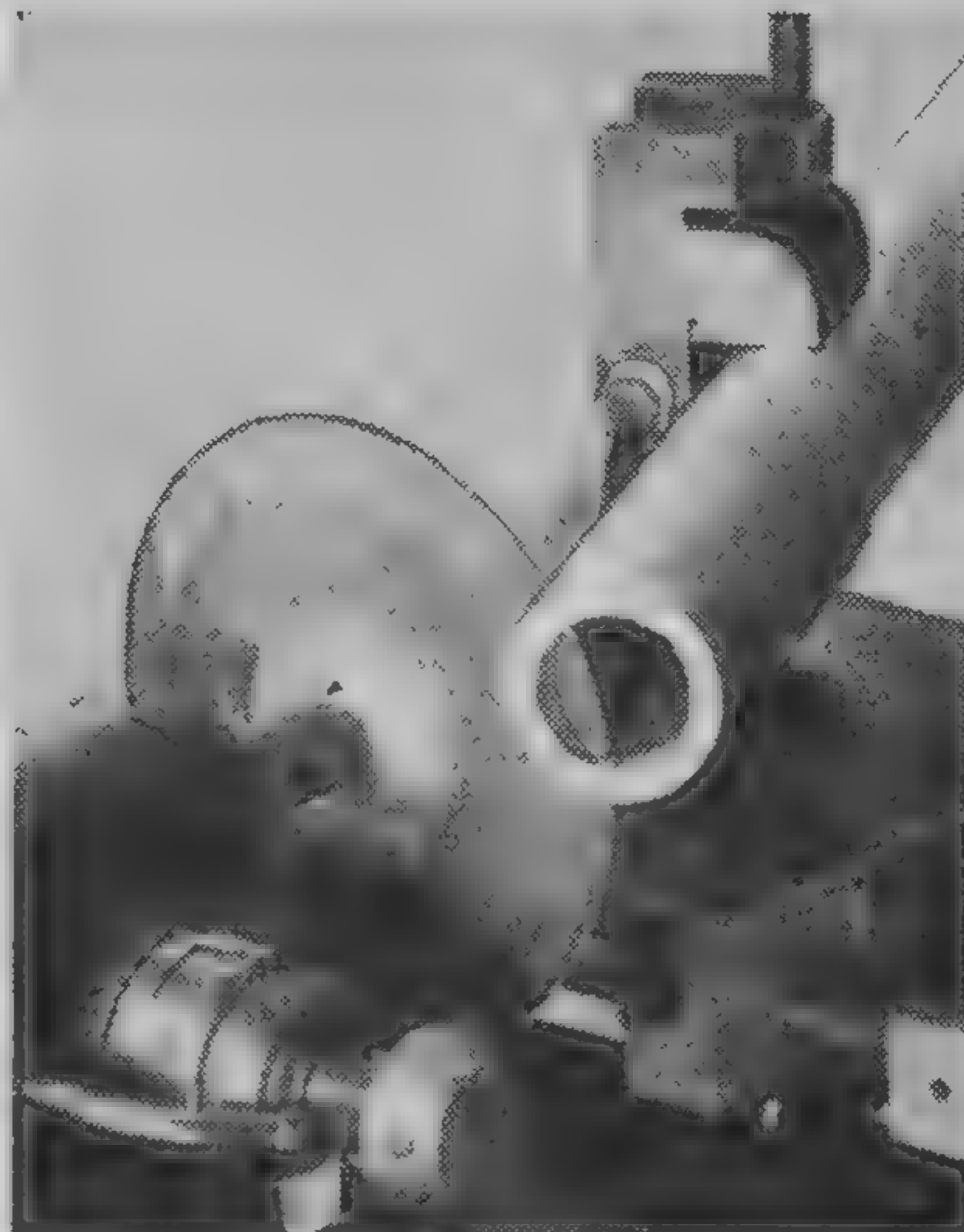
When doing pivot cutting with the stand, be sure pivot is exactly the height of the tool table, and that it is lined up with the cutting edge of the blade.—R. J. DECRISTOFORO.



Casters may be added to cabinet stand to provide work support.


PIVOT JIG
CABINET STAND

Unique Cross-Feed Table Multiplies Shopsmith Uses



Cutting this big steel tube accurately would have been a tough job by hand. The cross-feed and vise produce a precise angle cut, with the high-speed flexible abrasive wheel. Feed slowly, standing away from the cutting line, and ALWAYS wear safety glasses.

You can cut, grind slots, or mill metal with slip-proof precision, using this versatile accessory

By BILL McHUGH

BORROWING a design principle from big machine tools, this cross-feed table takes advantage of the double-column strength of the Shopsmith, to give you a means of feeding work to the tool, with controlled precision.

The cross feed has three main advantages: as in Fig. 1, you can use it with an adjustable vise to cut, drill, sand, and saw at practically any angle. Or, (Fig. 2) you can use it to slowly feed the work to a cutting tool to do a job that usually would require a milling machine. Figure 3 shows it doing a precise metal sawing job.

While the cross-fed attachment is shown on the Shopsmith model 10-ER, it will work equally well on the later Mark II, and Mark V models, and also on similar combination tools provided that you change the dimensions of the support bars (Fig. 6).

Construction requires accurate layout. You can build the entire project on your Shopsmith itself, provided that you improvise a drilling table, and

a slow-speed attachment. Both will be useful for other metal, wood and plastic jobs later on.

Make the metal drilling table shown in Fig. 4, of $\frac{3}{8}$ -in. cold rolled flat steel plate. With your Shopsmith vertical, place the two 1" support bars in the carriage. (For Mark II, or Mark V Shopsmiths, use $1\frac{1}{4}$ -in. support bars.) Then place the steel plate on top of the bars resting flush against the carriage. Clamp firmly, and drill two of the $1\frac{3}{4}$ " holes through the bars and plate, with a portable electric drill. Tap, countersink, and install the first two screws. This method guarantees better alignment and prevents the bars from shifting during the drilling of the other four holes. Drill the center hole, with a boring tool, or fly cutter working through from both sides.

The cross-feed (Fig. 6) requires that you drill or bore six 1" holes in the square bars, which means you will need slower spindle speed (100-150 rpm) than is usually available on the Shopsmith. Another story in this issue, "How To Bore the Big Ones," page 154, shows how to reduce spindle speed of an ordinary drill press.



The cross feed converts a heavy-duty milling machine. This is cut by feeding slowly with a 2-flute milling cutter.

Slow speeds down to 100 rpm are obtained with a Shopsmith slow-speed attachment (Fig. 7A). If you have this attachment, reduce the speed to the slowest setting, substituting an 8 inch pull stock pulley, with V-belt, to bore out to $1\frac{3}{16}$ -in.

An alternate method (Fig. 7B) which fits on the Shopsmith. Any of these slow speed attachments prove useful not only for slow speed working jobs.

Cold rolled steel bars (Fig. 6) can be obtained from any steel warehouse. They are made of Masonite, which is available from Masonite services. Similar in composition to boards, this material is like very hard wood, or has a tendency to split. A substitute regular 1-in. pillar portion and eliminate on.

Begin layout on one side with blue layout fluid, or any other locate all the holes with a sharp new drill, using machine oil, with the work solid.

Using the first bar as a guide, locate the hole locations through the bar, and also the sliding the holes with the $1\frac{3}{4}$ -in. holes up to 1 in.

Table smith Uses



steel tube accurately
a tough job by hand.
nd vise produce a pre-
with the high-speed flex-
eel. Feed slowly, stand-
the cutting line, and
ear safety glasses.

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table shown in Fig.
steel plate. With your
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available on the Shop-
his issue, "How To
154, shows how to
ordinary drill press.



The cross feed converts your Shopsmith into a light duty milling machine. This slot in an aluminum plate is cut by feeding slowly back and forth, with a 2-flute milling cutter held in a router chuck.

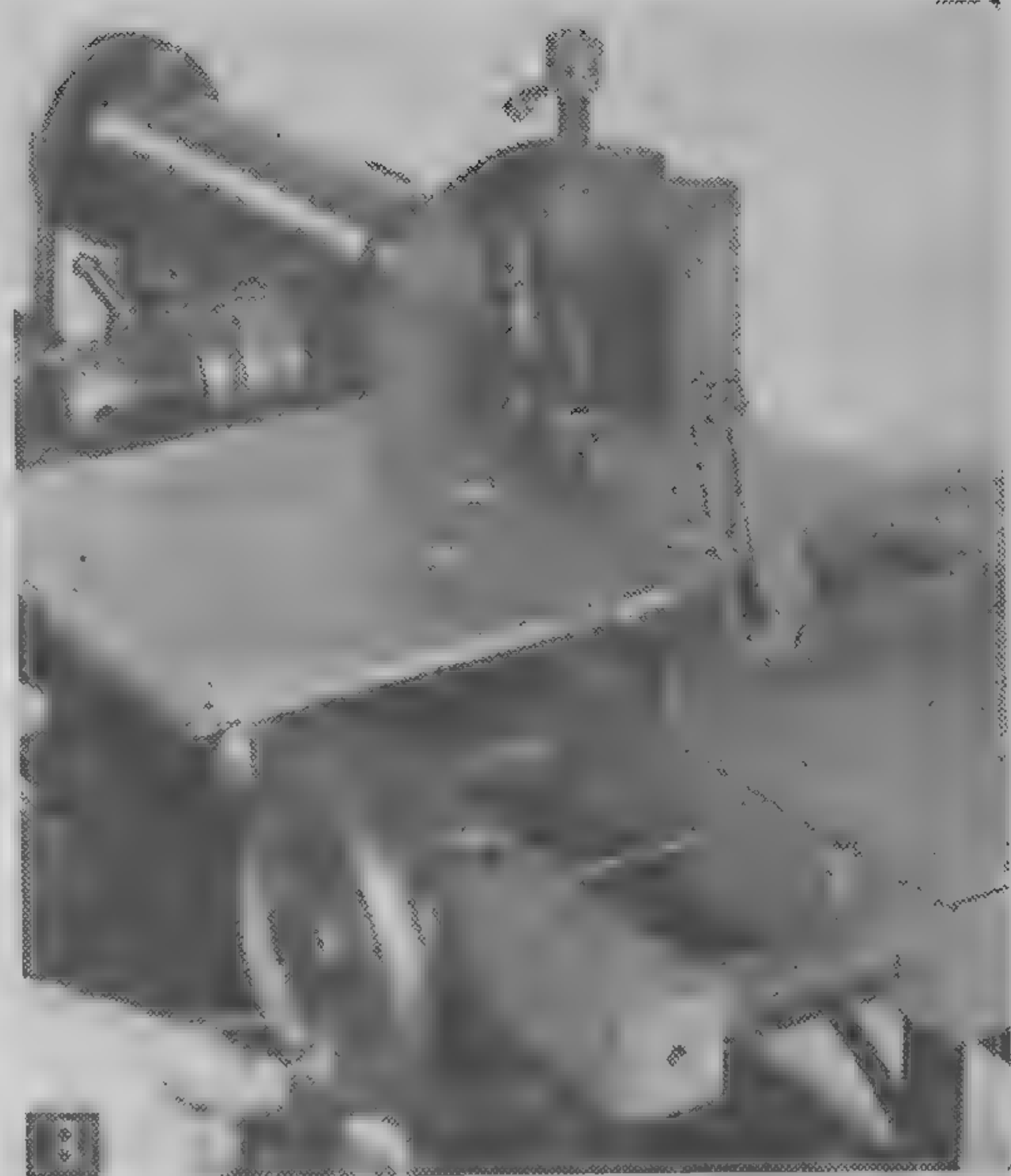
Slow speeds down to about 400 rpm can be obtained with a Shopsmith accessory originally offered, but no longer generally available (Fig. 7A). If you have this speed changer, you can reduce the speed to the 150 rpm range by substituting an 8 inch pulley for the regular head-stock pulley, with V-belt to fit. Drill the pulley bore out to $1\frac{3}{16}$ -in.

An alternate method is to build a jackshaft (Fig. 7B) which fits on one side of the Shopsmith. Any of these slow-speed modifications will prove useful not only for drilling, but other metal working jobs.

Cold rolled steel bars required for the attachment (Fig. 6) can be ordered cut to length from any steel warehouse. The sliding bearing blocks are made of Masonite Benelex "70" die stock, available from Masonite distributors and cutting services. Similar in composition to familiar hardboards, this material is tough and dense. It cuts like very hard wood, or plastic, but has no grain or tendency to split. Alternately, you can substitute regular 1-in. pillow blocks for the sliding portion and eliminate one step in construction.

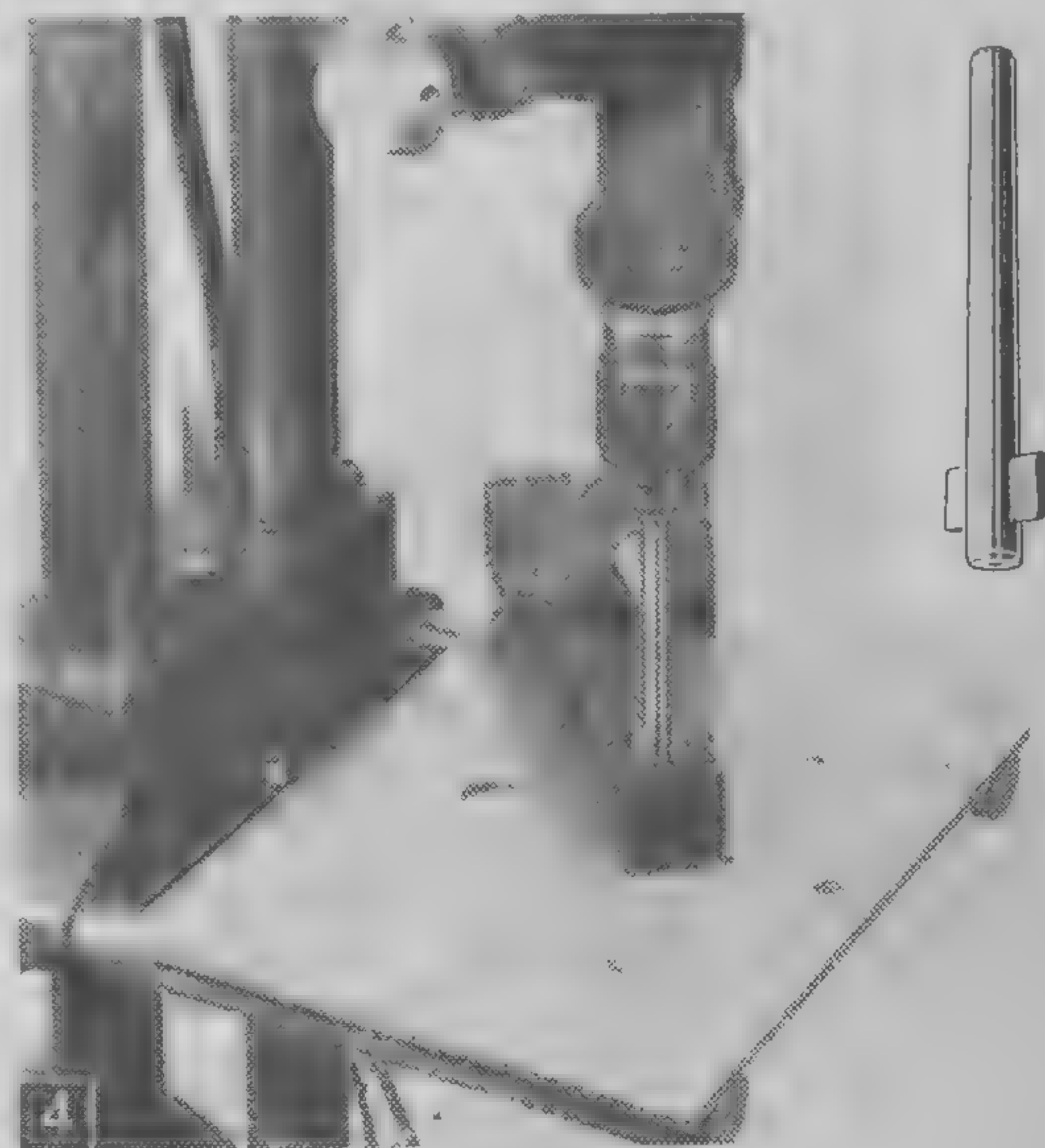
Begin layout on one of the square bars. Use blue layout fluid, or any thin metal lacquer, and locate all the holes with a small center drill. Then enlarge the holes to $\frac{1}{4}$ -in., drilling with a sharp new drill, using moderate speed and plenty of oil, with the work solidly clamped.

Using the first bar as a template, transfer the hole locations through to the second square steel bar, and also the sliding blocks, simply by starting the holes with the $\frac{1}{4}$ -in. drill. Then enlarge the $\frac{1}{4}$ -in. holes up to 1 inch using oversize black-

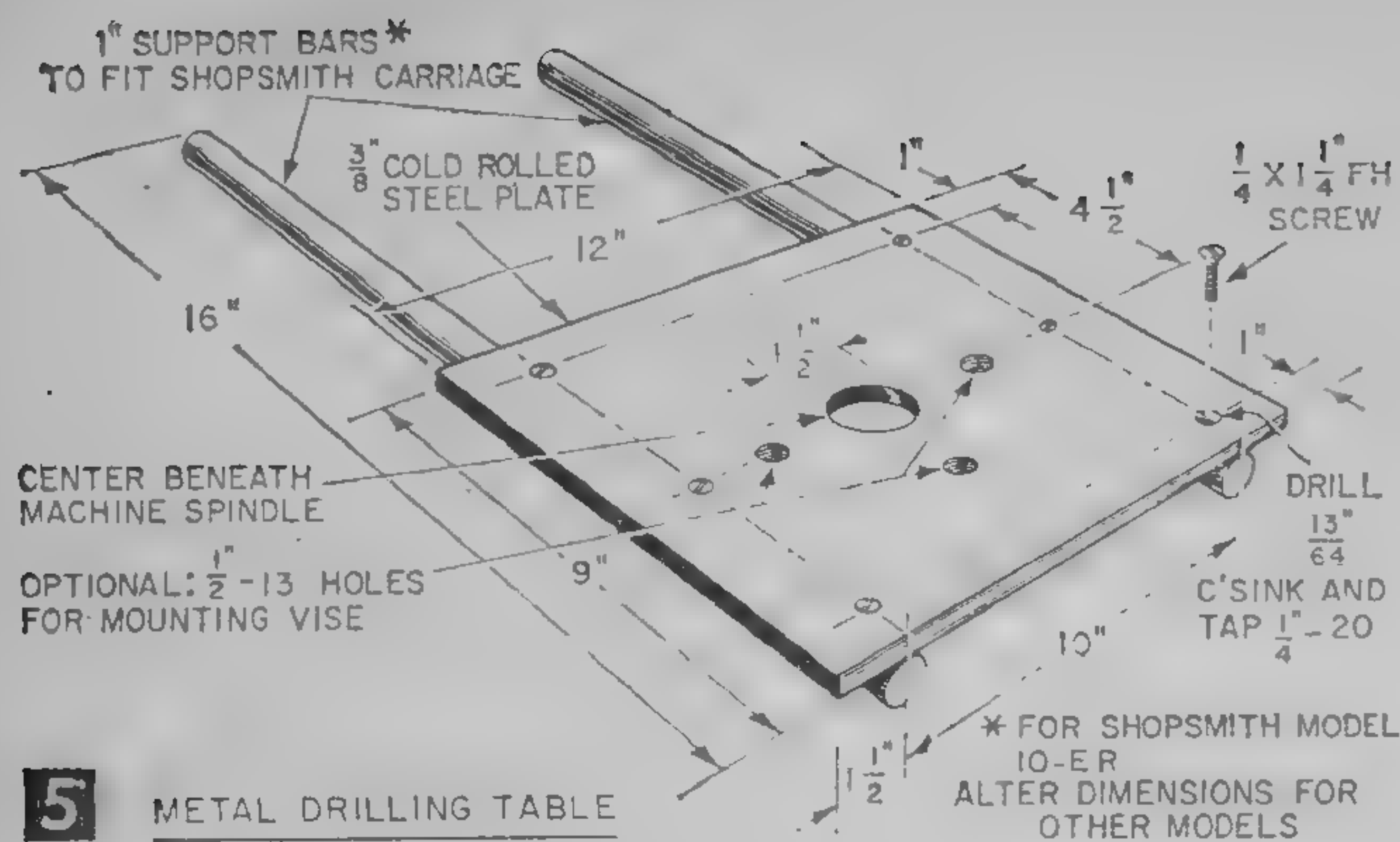


Sawing soft metal plate on a table saw is often dangerous because the work can slip and jam. The cross feed grips the work solidly for safe even cutting. Keep aluminum work cool with water, or soluble oil.

smith drills with $\frac{1}{2}$ -in. shanks. An alternate method of drilling large holes utilizes an "Econo-Bore" tool recently offered by DoAll Corporation, Des Plaines, Ill. The tool shown in Fig. 4, has a $1\frac{5}{32}$ " shank, which costs \$4.35. The 1 inch cutter costs \$1.50, and is interchangeable with other fractional sizes that fit the same shank.



Use a flat piece of steel plate to make this sturdy metal drilling table. Threaded holes are used to mount an adjustable vise, and are handy for improvising clamping fixtures.



Using this tool, first enlarge your 1/4-in. holes up to 15/32-in. The Econo-Bore tip will follow right down cutting a precise 1-in. hole. But be sure to stop short of breaking through. Turn the

MATERIALS LIST—CROSS FEED TABLE

No. Req'd	Size and Description
2	1 x 13" cold rolled round steel bars *
2	1 x 20" cold rolled round steel bars
2	1 1/2 x 1 1/2 x 10" cold rolled square steel bars
2	1 3/8 x 2 1/4 x 11" pieces Masonite Benelex "70" (cut from 1 3/8" stock)
1	11 x 11 1/2 x 1/4" cold rolled steel plate
1	3/8 x 2 x 6 3/4" cold rolled steel plate
1	1/2"-13 x 15" threaded rod (Redi-Bolt or equal)
1	4 1/2" dia. 1/2" bore handwheel (Chicago Die Casting #186NS)
2	1/2" underground radial thrust bearings (Boston Gear #5169)
1	1/2" collar & nut
8	1/4"-20 x 2 1/2" fh stove bolts & nuts
2	1/4"-20 x 2" fh stove bolts & nuts
16	5/16"-18 x 1/4" socket head set screws

DRILLING TABLE

1 3/8 x 9 x 12" cold rolled steel plate
2 1 x 16" cold rolled round steel bars *
6 1/4"-20 x 1 1/4" fh machine screws

* Use 1¼" dia. round bars for Shopsmith Models Mark II and V. See text.

work piece over and cut through from the other side. The 1-in. tool must be used at speeds around 100 rpm, with plenty of cutting oil.

Now, drill and tap the holes (Fig. 6) for the set screws, removing any inside burrs that may develop. The screw feed is an inexpensive $\frac{1}{2}$ in.-13 threaded rod, available in hardware stores. It feeds through a threaded plate and is held at one end by a nut and collar. The handwheel can be improvised, or the one shown in Fig. 9 can be purchased in large hardware and mill supply stores. Ball bearing thrust washers provide a smooth screw action; however, sev-

If your sliding blocks tend to seize, it may be necessary to ream the holes slightly. Tighten the socket-head screws that hold each bar. You may want to weld the main support bars permanently in place to avoid any slight mis-alignment later. The unit should fit the Shopsmith perfectly, sliding in and out of the carriage holes freely.

Drilling of the holes in the table plate is optional depending on the kind of vise you plan to use. A Palmgren #000 drill press vise is shown in Fig. 1, and it is fastened through its bottom plate with a $\frac{1}{2}$ in.-13 socket head screw. Extra holes and slots will enable you to mount other vises, and special fixtures. After you complete your cross feed table, you will find that you can quickly set it up to handle many different kinds of metal working jobs.

If you are used to working only in wood, take special note of metal-working safety precautions. While wood shavings and saw dust are quite harmless, metal chips and abrasive dust can cause painful eye injuries.

ies. In a hurry, it is all too easy to misplace your safety glasses, and operate your tools without eye protection. Improvise a plastic hood for your machine, or simply make a bracket, to hold a shield of safety glass, and bolt to the Shopsmith frame. Even then, wear the goggles whenever the machine is running, and stand away from the cutting line.

the feed, taking light time as you travel back to work. Trying to cut too to grab, or chatter, and ing cutters and routers the Jacob's chuck support since side strain may a don't forget to use the p

Use coarse grade *flex* rough fast cutting (Fig. for close small jobs. Avoid wheel, or cutting stone, dangerously. Since wheel and small chips, a guard plus glasses. Keep the water spray, and if you out of the cut and allow continuing. Proper wheel recommendations for use tools, can be found in m

Since metal chips and the tubular ways of y them with cloth covers, able aluminum cooking f

Milling cutters and router metal saws, are usually of the same kind of metal. For example, steel generally requires wider, more teeth with fewer flutes to allow for chip removal while cast iron is usually more brittle and needs more teeth.

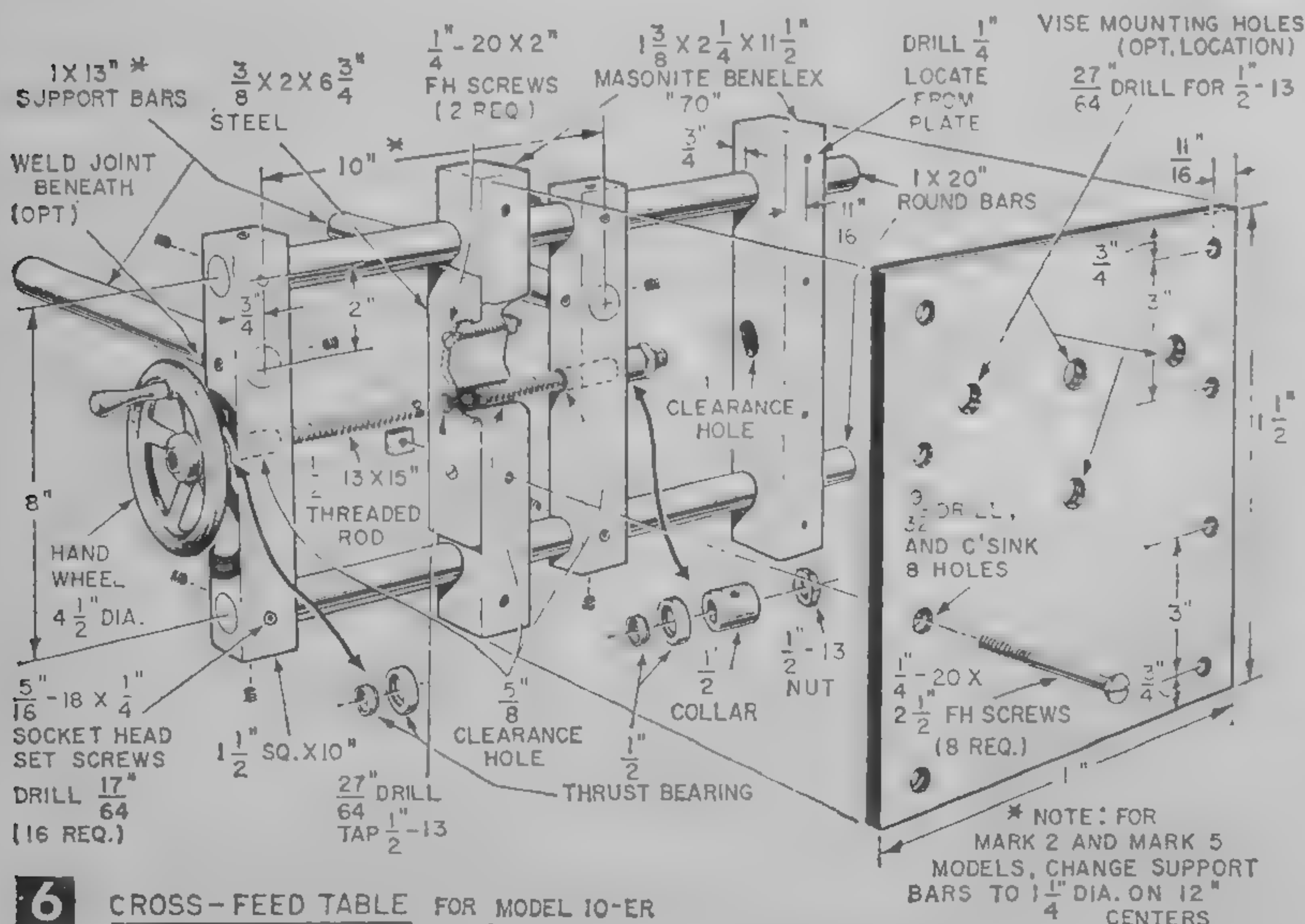


Fig. 8. The adjustable vise and quick setup for drilling at extreme angles, saw or chisel locating the hole and

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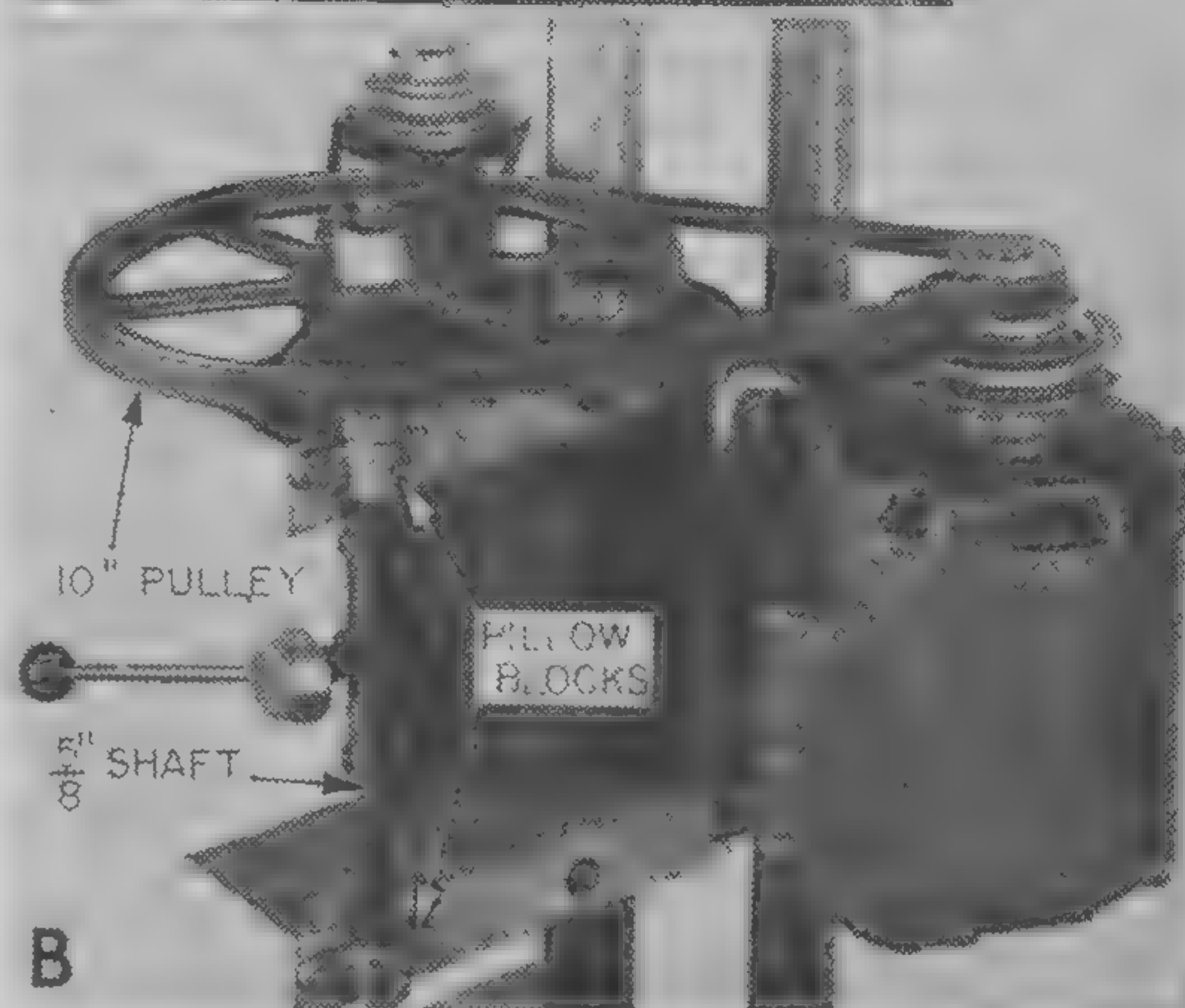
Cutting feed and tool
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Fig. 2) avoid forcing

the feed, taking light repeat cuts deeper each
time as you travel back and forth across the
work. Trying to cut too fast will cause the tool
to grab, or chatter, and it may even break. Mill-
ing cutters and routers should never be used in
the Jacob's chuck supplied with the machine,
since side strain may affect the accuracy. And
don't forget to use the proper cutting fluids.

Use coarse grade *flexible* abrasive wheels for
rough fast cutting (Fig. 9) and fine grain wheels
for close small jobs. Avoid any brittle grinding
wheel, or cutting stone, since they may shatter
dangerously. Since wheels throw abrasive dust
and small chips, a guard is necessary, (Fig. 9)
plus glasses. Keep the work piece cool with fine
water spray, and if your metal heats up, back
out of the cut and allow the work to cool before
continuing. Proper wheel speeds, as well as
recommendations for using all metal working
tools, can be found in manufacturer's literature.

Since metal chips and abrasive dust can harm
the tubular ways of your Shopsmith, protect
them with cloth covers, or the commonly avail-
able aluminum cooking foil.

Milling cutters and routing tools, as well as
metal saws, are usually designed for one particu-
lar kind of metal. For example, aluminum gen-
erally requires wider, more open milling cutters
with fewer flutes to allow stringy chips to clear,
while cast iron is usually cut with a mill that has
more teeth.



If you have a slow-speed attachment, (A) the 10 inch pulley on your headstock will give you the right speed for boring steel with the 1-inch Econo-Bore. The improvised jack-shaft (B) will produce same result. Higher rpm would cause this tool, or a large drill to chatter.

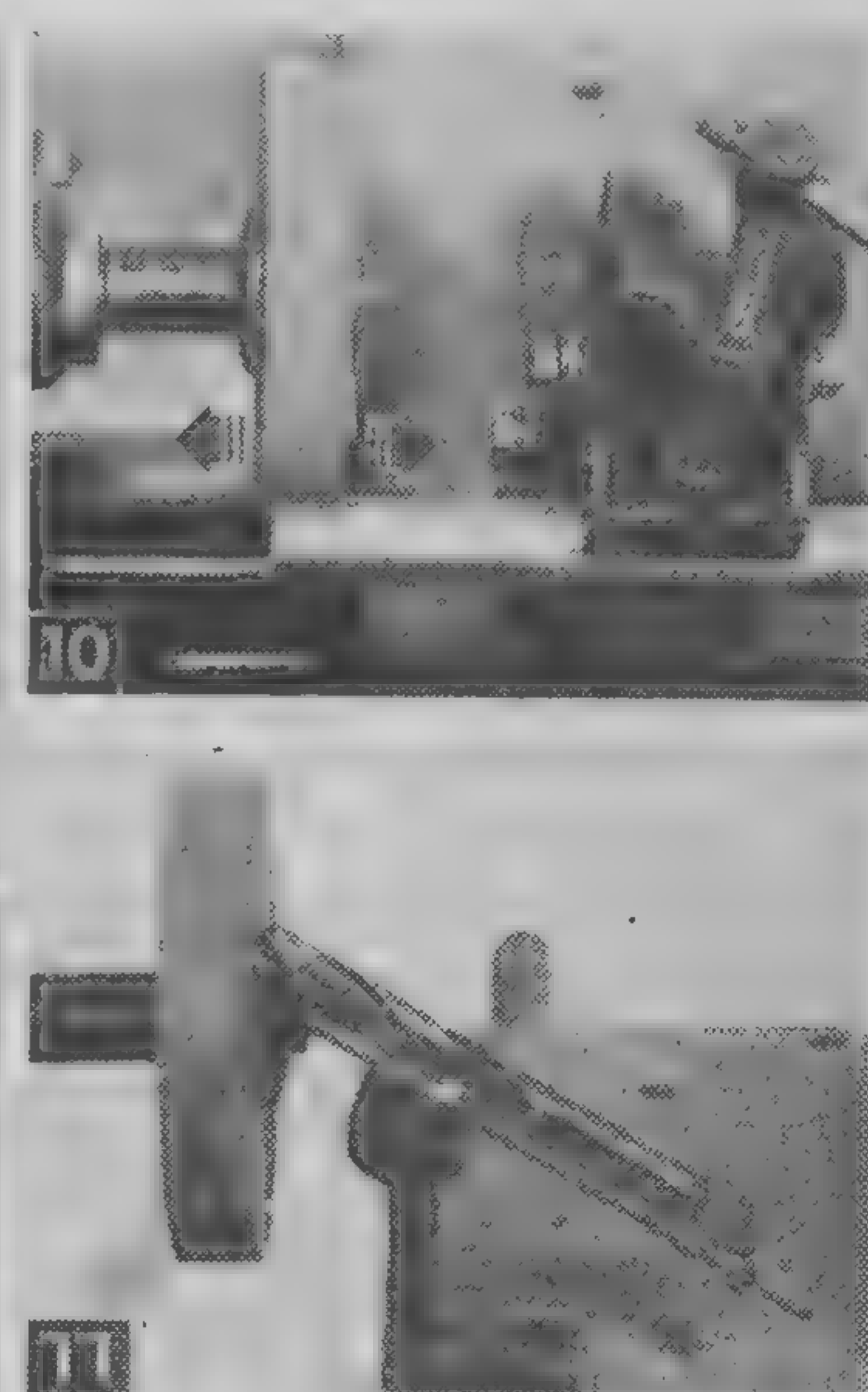
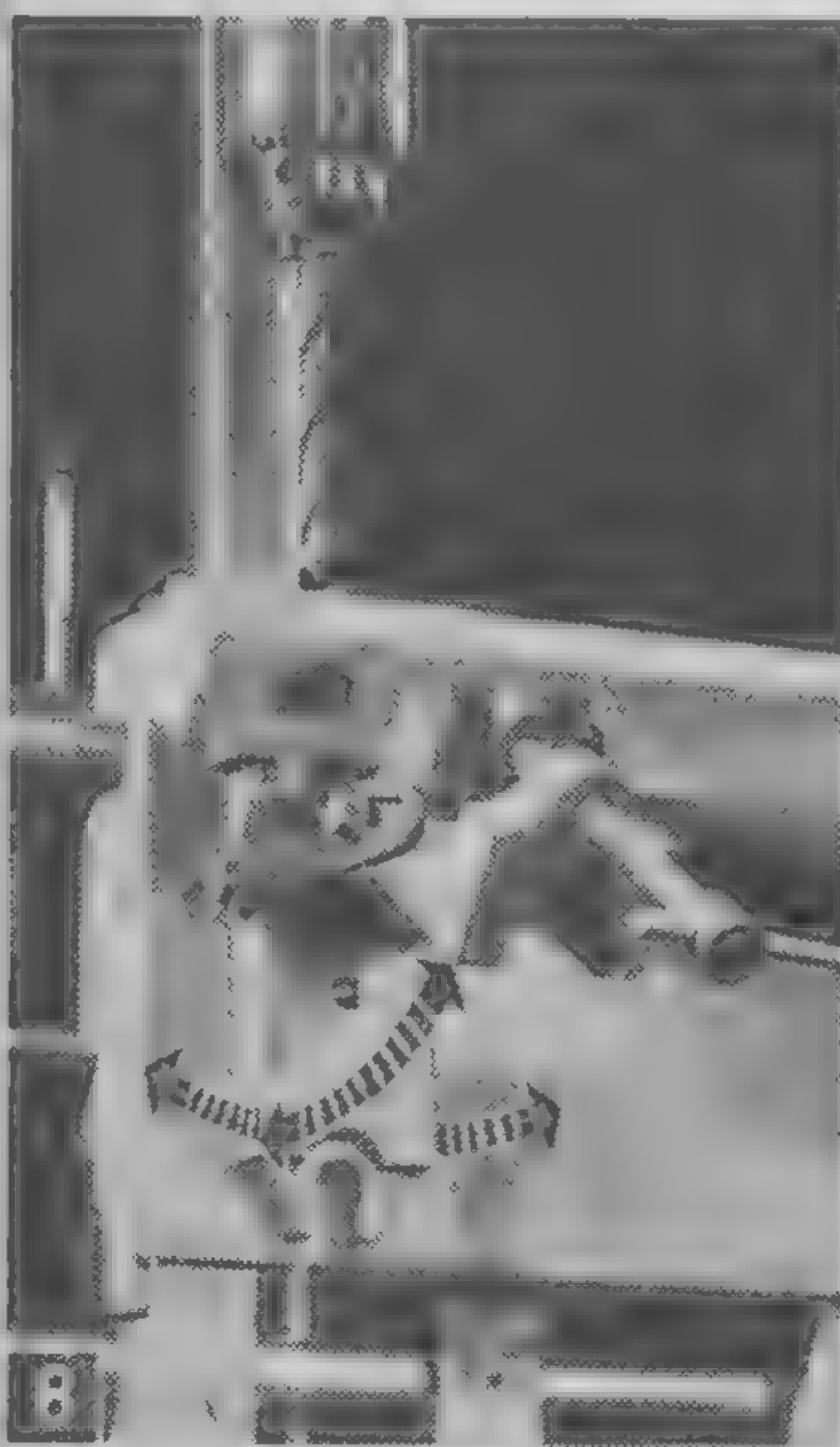


Fig. 8. The adjustable vise and cross feed give you a quick setup for drilling at any complex angle. At extreme angles, saw or chisel a spot on the work for locating the hole and starting the drill.

Fig. 9. Cut long lengths of conduit, metal tubing or bars with the flexible abrasive wheel. Always stand away from the work. A safety guard can be made of clear plastic. The bed of the machine should be protected from abrasive dust and chips.

Fig. 10. Grind a flat on a shaft by feeding the wheel slowly back and forth with the headstock quill. Use a guard and be sure to wear glasses. Let the speed do the work, feeding with light even minimum pressure.

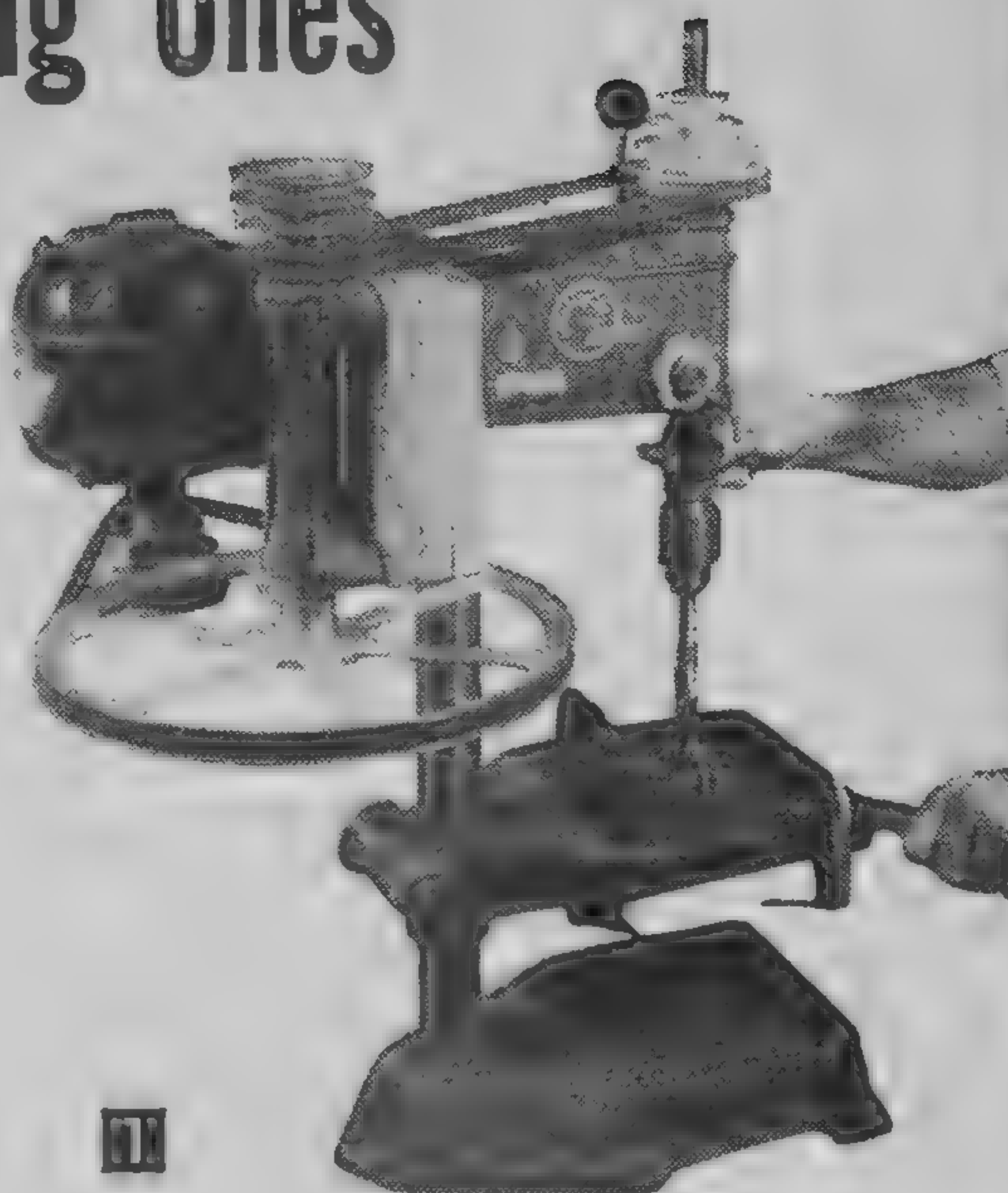
Fig. 11. Sharpening drills of various sizes, as well as other tools, is simplified with completely flexible locating adjustments provided by the cross-feed and the Shopsmith.

How to Bore the Big Ones

THERE'S a secret to boring up to 1-in. dia. holes through steel with a 1/2-in. capacity drill press. You reduce the speed of the drill bit and increase the torque with a speed-reducer.

The speed-reducer is simply a jack-shaft consisting of a mandrel with a 4-step cone pulley on one end and a 12-in. pulley on the other end as in Fig. 1. This reduces the drill press chuck speed to a low of about 125 rpm and a high of about 600 rpm, depending on how the cone pulleys are belted.

Cut the mounting board and spacers to size as given in Fig. 2 and the Materials List, and bolt the assembled mandrel and pulleys to the mounting board with the spacers under the mandrel. The spacers are needed to provide clearance between the drill press post and the 12-in. pulley. Then remove the motor from the drill press and temporarily fasten the mounting board to the motor bracket with c-clamps. Hold a straight-edge across the two cone pulleys and align them by repositioning the mounting board so that the V-belt will run true. Mark the location of the



Drill bits having 1/2-in. shanks for chucking are available for boring 3/8 to 1-in. dia. holes.

slotted bolt holes in the motor bracket on the mounting board, remove the board and drill the 1 1/2-in. holes, countersinking them on the side the mandrel is fastened.

Now, place the motor on the board so that a 46-in. long V-belt will go around the 12-in. pulley and the smallest pulley on the motor cone pulley. Align the pulleys, and mark and drill the board for motor mounting bolts. Countersink these holes and bolt the motor to the board.

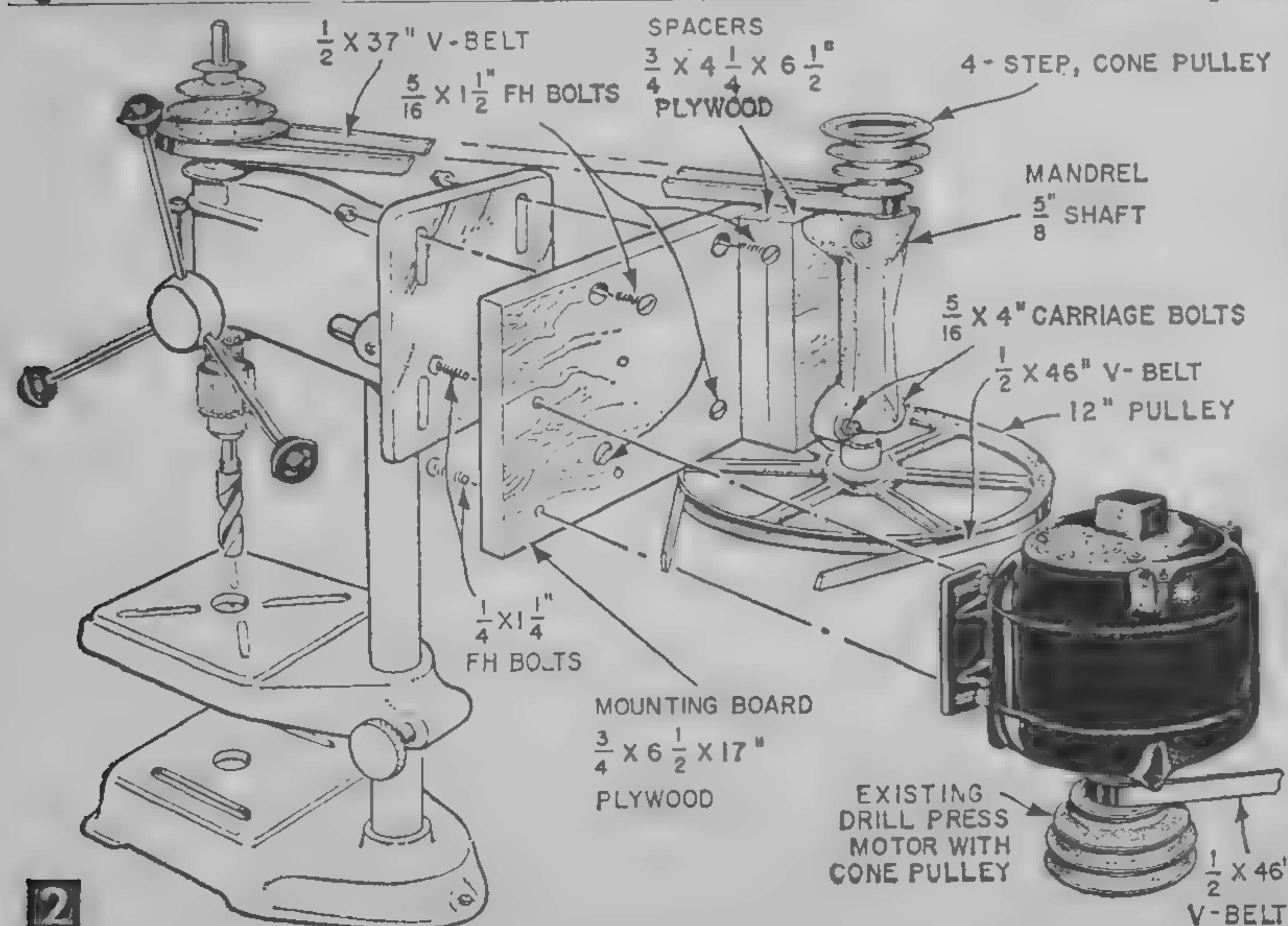
Since the motor must be turned upside down from its normal operating position, it will have to be reversed. Remove the plate covering the electrical connections and change the wiring as noted on the diagram on the back of the cover plate.

If your drill press motor has a double ended shaft, it will not have to be reversed. Simply use it in its normal position and place a 2-in. pulley on the lower end of the motor shaft to drive the 12-in. pulley.

When boring a hole, start with a 3/8-in. drill bit and enlarge the hole with 1/8-in. larger drill bits until the required size is reached.—ART YOUNGQUIST.

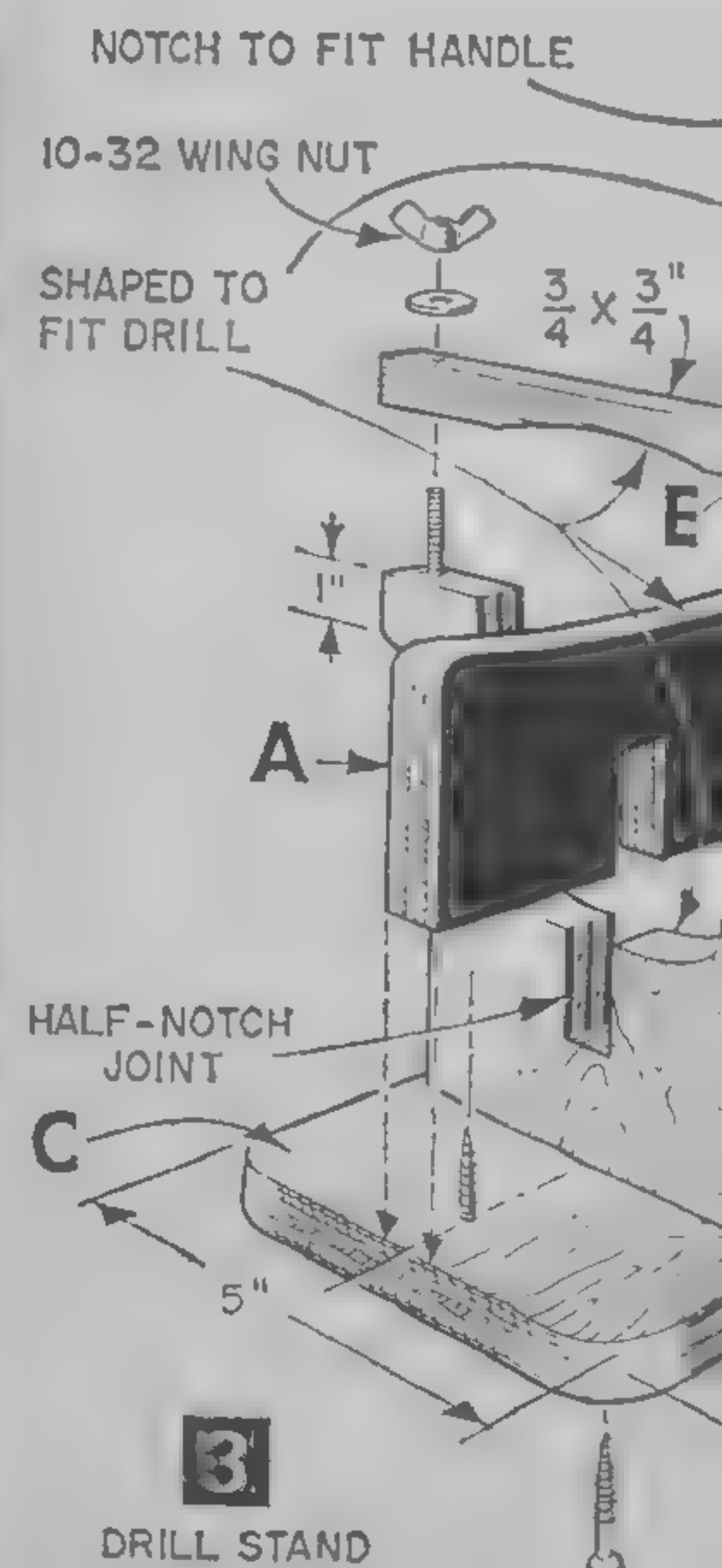
MATERIALS LIST—DRILL SPEED-REDUCER

No. Req.	Size and Description	Use
1	3/4 x 6 1/2 x 17" plywood	mounting board
2	3/4 x 4 1/4 x 6 1/2" plywood	spacers
1	1/2 x 37" V-belt	drill press pulley
1	1/2 x 46" V-belt	motor pulley
4	5/16 x 4" carriage bolts	mandrel
4	5/16 x 1 1/2" fh bolts	mounting board
4	1/4 x 1 1/4" fh bolts	motor
	(the following parts made by Chicago Die Casting, available from your local hardware store)	
1	#1560, 5/8" shaft dia. ball bearing mandrel	
1	#140, 4-step, V-grooved, 5/8" bore step pulley	
1	#1200A 5/8" bore x 12" dia. V-grooved pulley	



MADE of scrap p in. stock or pl drill stand will portable electric drill tionary, bench-mount tool (Fig. 1) for grinding knives, wire brush clean metal parts or drum and of hand-held pieces.

Since the various models of drills vary shape, determine the the stand parts directly drill. Starting with part





shanks for chucking are $\frac{1}{8}$ to 1-in. dia. holes.

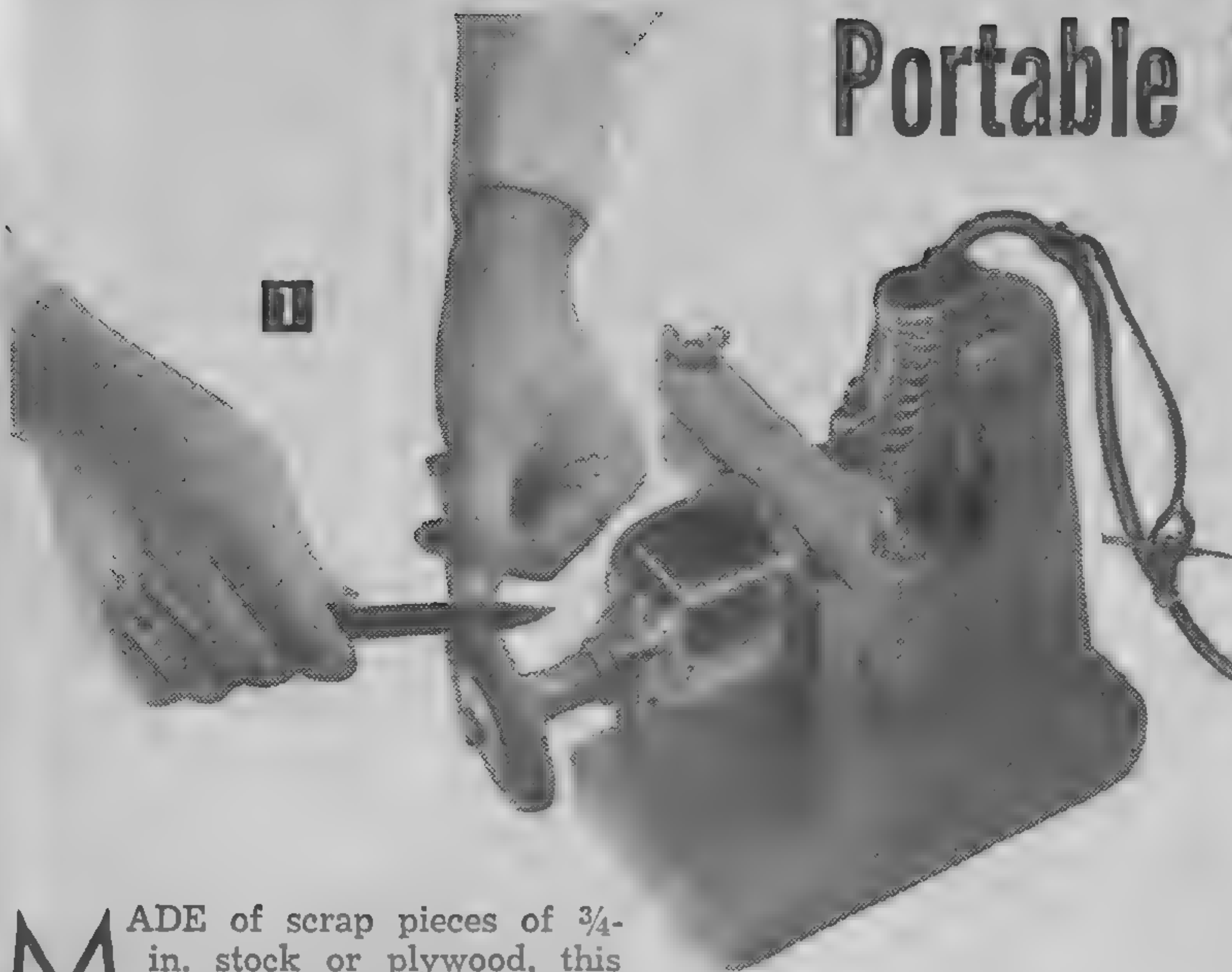
the motor bracket on the board and drill the mounting holes on the side.

on the board so that it is around the 12-in. pulley on the motor cone pulley. Mark and drill the board for the bolts. Countersink these holes to the board.

When turned upside down in working position, it will have to be reversed. Remove the plate covering the electrical connections and change the wiring as noted on the diagram on the back of the cover plate.

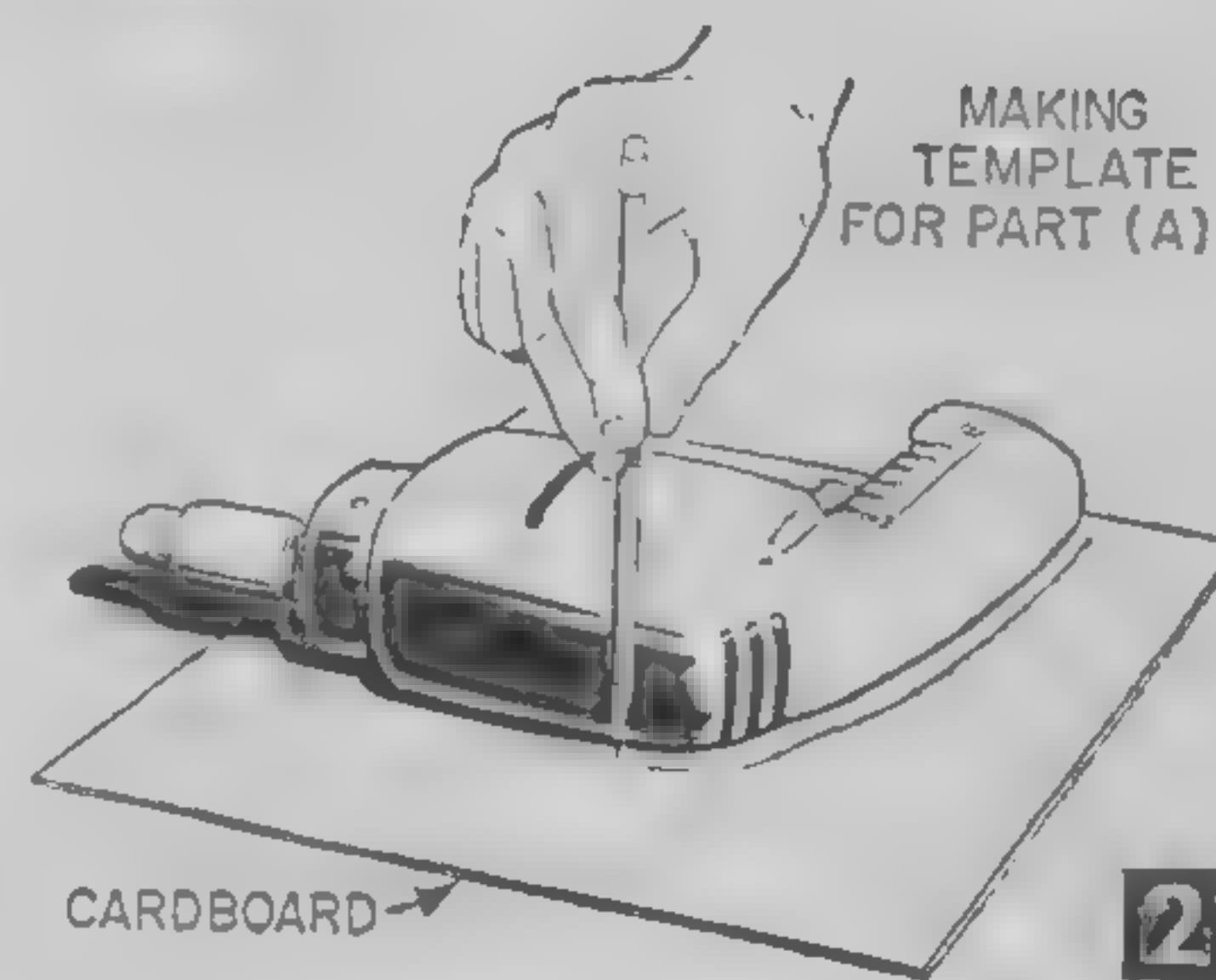
If your drill press motor has a double ended shaft, it will not have to be reversed. Simply use it in its normal position and place a 2-in. pulley on the lower end of the motor shaft to drive the 12-in. pulley.

When boring a hole, start with a $\frac{3}{8}$ -in. drill bit and enlarge the hole with $\frac{1}{8}$ -in. larger drill bits until the required size is reached.—ART YOUNGQUIST.



MADE of scrap pieces of $\frac{3}{4}$ -in. stock or plywood, this drill stand will convert your portable electric drill into a stationary, bench-mounted power tool (Fig. 1) for grinding tools and knives, wire brush cleaning of small metal parts or drum and disc sanding of hand-held pieces.

Since the various makes and models of drills vary in size and shape, determine the dimensions of the stand parts directly from your drill. Starting with part A (Fig. 2),



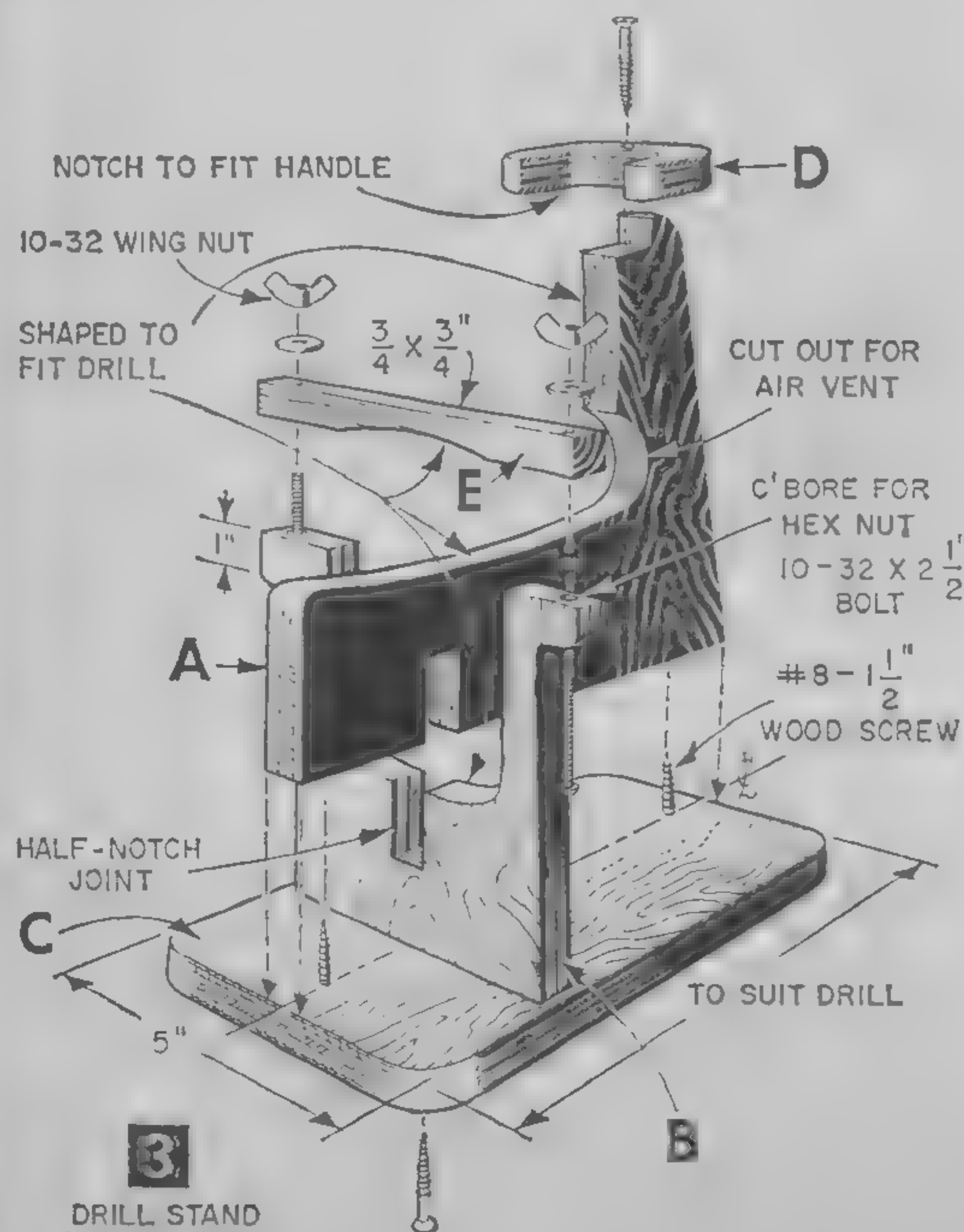
MAKING TEMPLATE FOR PART (A)

CARDBOARD

2

than the drill handle width. Notch the top of part A for part D and screw the latter in place to secure the drill handle in a vertical position. Make a pattern for part E, transfer to stock and cut out. Drill two holes to align with those in part B in which the #10-32 bolts are mounted. Washers and wing nuts secure this part in place and permit easy drill removal. Finish the stand as desired.

In use, fasten the stand to the bench top with a clamp or screws, or grip in a wood vise.—J. V.



Powered Edge Planer from an Old Vacuum Motor

A $\frac{1}{8}$ - $\frac{1}{4}$ -hp vacuum-cleaner motor of the universal ac-dc type powers this handy tool for planing sawed lumber edges smooth and square (Fig. 1). You can dress stock up to $\frac{7}{8}$ -in. thick with the 3-lip, factory-made cutter shown in Fig. 2.

First, secure the motor from a vacuum-cleaner repair shop. It should have an attaching flange similar to that shown in Figs. 2 and 3, and a $\frac{5}{16}$ in. diameter shaft at least $1\frac{1}{4}$ in. long without a threaded end. Check the motor shaft to see that it runs smoothly and without shaft wobble or end play. Mine cost \$2 and I reconditioned it with new carbon brushes.

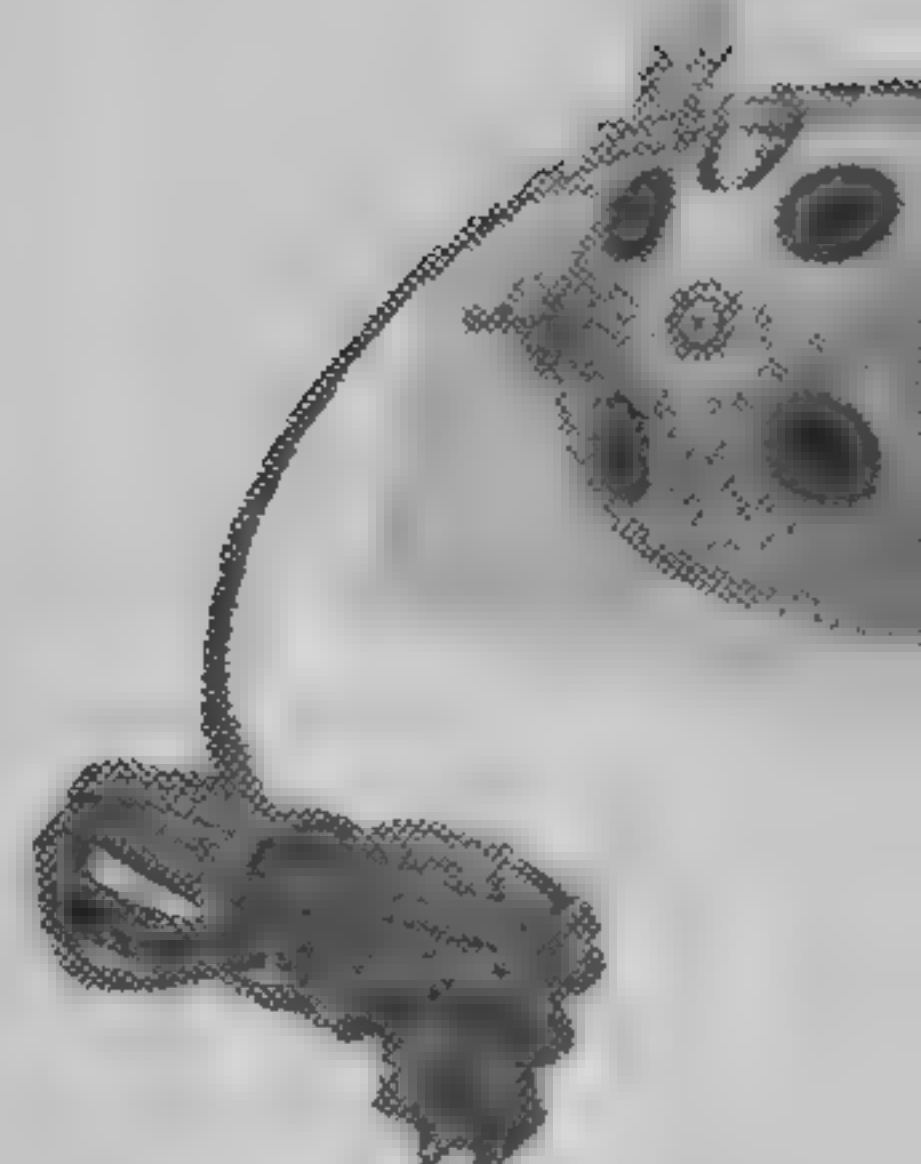
Because the mounting flange diameter on these motors varies in size with different makes, check the $2\frac{1}{2}$ -in. radius on the plane body (Fig. 2A) and guide plate (Fig. 2B) to see if it is large enough. The radius should be $\frac{1}{4}$ in. larger than the radius of the motor flange.

First cut out the plane body from two pieces of $\frac{1}{2}$ in. birch plywood glued together. Drill a $\frac{1}{4}$ in. hole at the back and a $\frac{5}{16}$ in. elongated slot at the front. Then recess the edge of the handle for a toggle switch and cut a notch for the pre-

Vacuum Motor



One pass of this planer across the edge of a board will remove $\frac{1}{32}$ in. of stock and leave a perfectly flat and square edge.



Mounting flange on vacuum motor bolted to guide plate

wired switch leads (Fig. 2C), hand grip (Fig. 2C), front of the body and body.

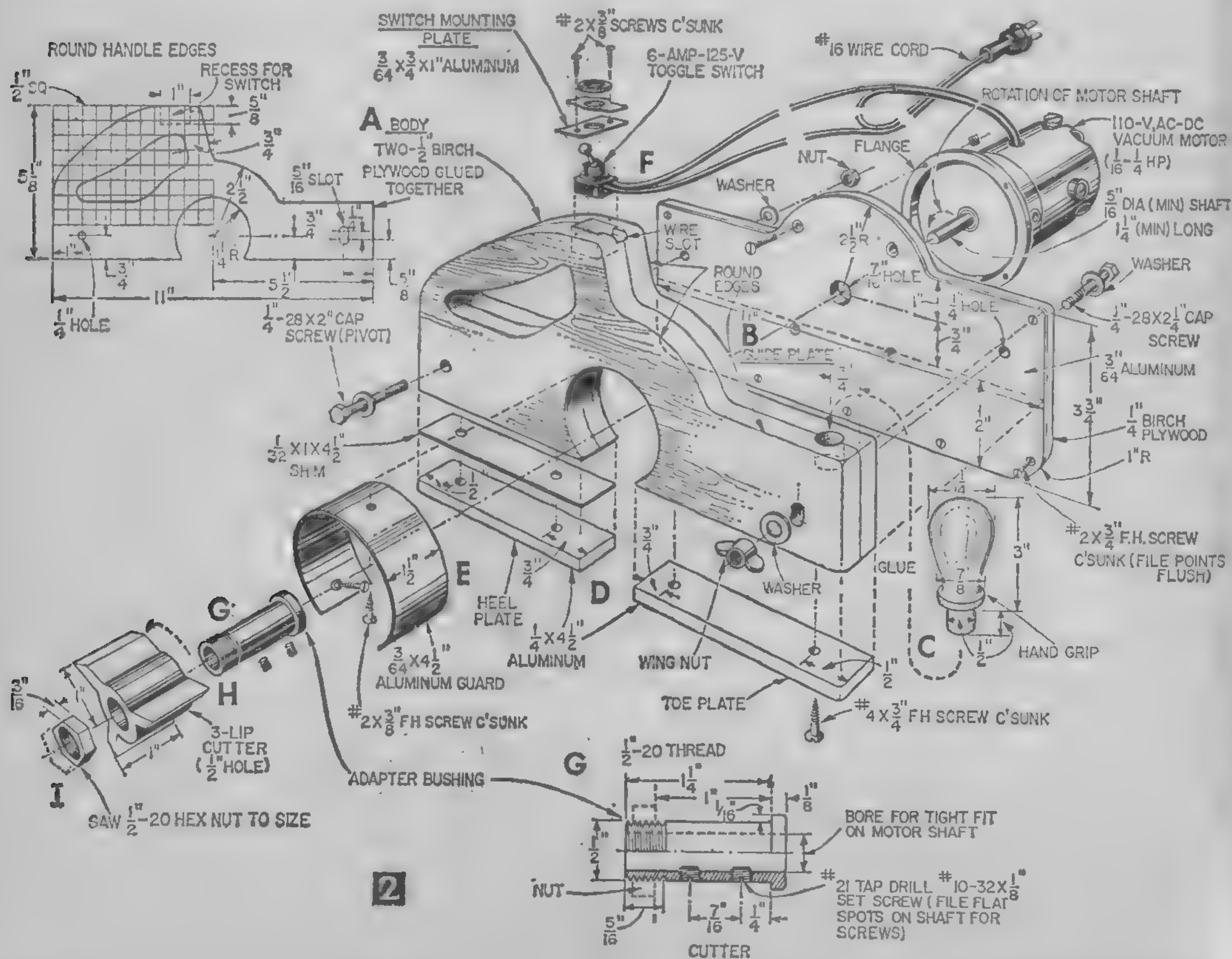
The guide plate is $\frac{1}{4}$ -in. plywood fastened to aluminum as in Fig. 2B with four #2 x $\frac{3}{8}$ in. screws. Cut out both plywood holes and cut out both plywood holes. Locate and drill the motor shaft, and position the motor, centering the shaft in the holes for motor mounting. Now, align and clamp the guide plate with two 1-in. holes through the plywood hole and $\frac{5}{16}$ -in. slot in the motor. Insert $\frac{1}{4}$ -in. cap screw and wing nut on the screw in the slot as in Fig. 2. The guide plate can be raised and lowered of the motor to adjust the planer.

From $\frac{1}{4}$ x 1-in. bar stock, cut a toe plate, and from

WHEN building a planer, you should use grooves in the wood. Grooves provide an escape for trapped air and glue, reducing chances of split work.

You can make straight cuts in dowel stock using a planer, as shown in Fig. 1. For more details, see Fig. 2 for making the planer.

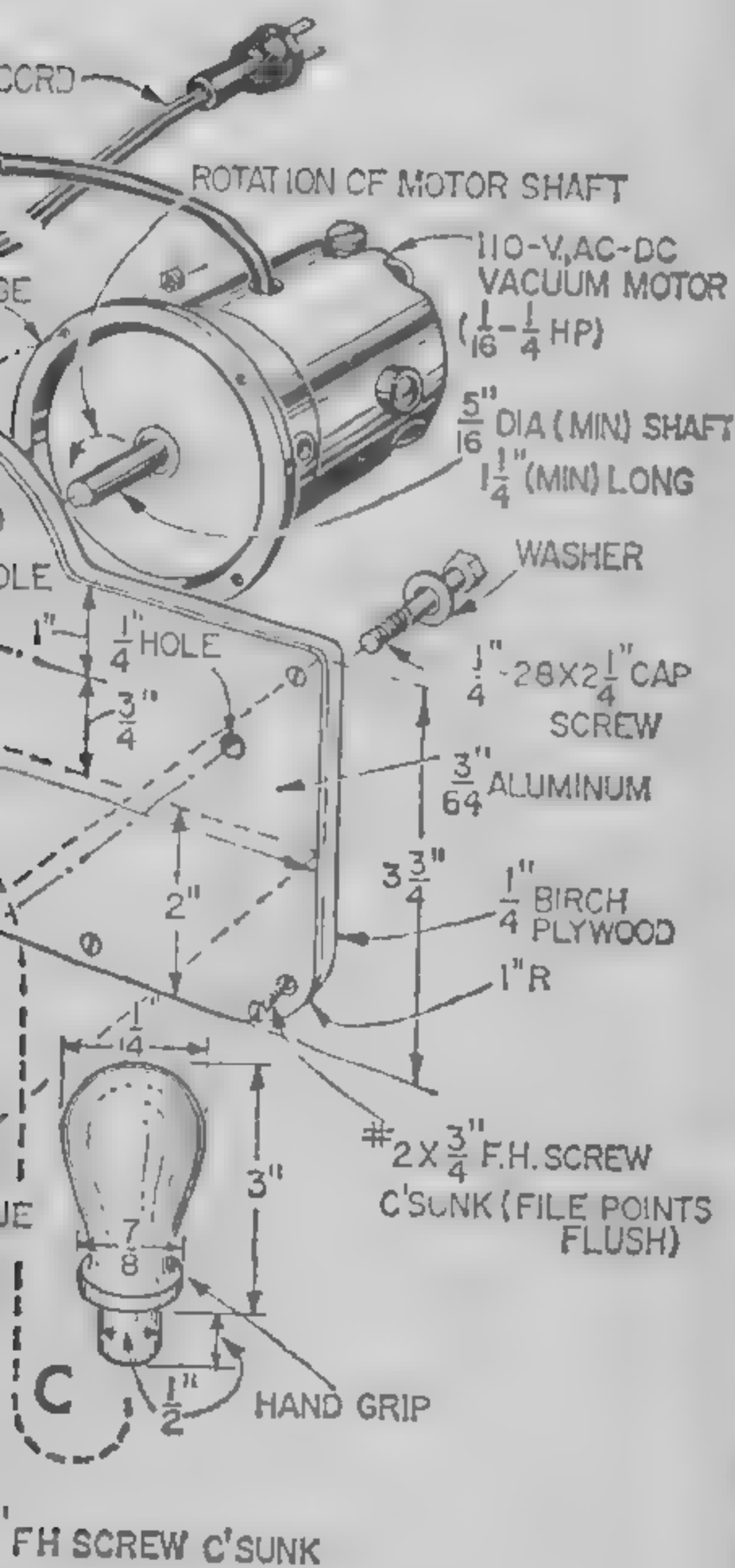
To use it, you push the planer through the hole and turn the thumb screw, set for a specific thickness. It does the rest. Be sure to make grooves on two sides.



an Old Motor



across the edge of a board
block and leave a perfectly flat
square edge.



OR TIGHT FIT
OR SHAFT

DRILL #10-32 X 1/8\"/>



Mounting flange on vacuum-cleaner motor is bolted to guide plate of portable planer body.

wired switch leads (Fig. 2F). After turning the hand grip (Fig. 2C), drill a 1/2-in. hole in the top, front of the body and glue the hand grip to the body.

The guide plate is made up of sheet aluminum and 1/4-in. plywood fastened together. Lay out the aluminum as in Fig. 2B, fasten it to the plywood with four #2 x 3/8 in. fh screws at the corners and cut out both pieces at once on a jigsaw. Locate and drill the 7/16-in. hole for the motor shaft, and position the motor on the guide plate, centering the shaft in the 7/16-in. hole. Then drill holes for motor mounting bolts, locating them from the holes in the motor flange. Countersink these holes on the aluminum side and bolt the motor to the plywood side of the guide plate. Now, align and clamp the plane body to the guide plate with two C-clamps and drill two 1/4 in. holes through the guide plate using the 1/4 in. hole and 5/16-in. slot in the body as drill bit guides.

Insert 1/4-in. cap screws in the holes using a wing nut on the screws going through the 5/16 in. slot as in Fig. 2. The slot will permit the raising and lowering of the body independent of the guide plate to adjust the depth of the cut of the planer.

From 1/4 x 1-in. bar aluminum cut a heel and toe plate, and from 1/32-in. sheet aluminum or

MATERIALS LIST—POWER PLANER

Amt. Req.	Size and Description	Use
1	universal-type, ac-dc, 1/8-1/4 hp vac motor	
1	6-amp., 125 v. toggle switch	
12 ft	#18 plastic-covered line cord with plug	
2	1/2 x 5 1/8 x 11" birch plywood	body
1	1/4 x 5 1/4 x 11" birch plywood	guide plate
1	3/4 x 5 1/4 x 11" aluminum sheet	guide plate
1	1 1/4" dia. x 3 1/2" hard or soft wood	hand grip
2	1/4 x 1 x 4 1/2" flat aluminum	heel and toe plates
1	1/32 x 1 x 4 1/2" aluminum	heel-plate shim
1	3/4 x 1 1/2 x 4 1/2" aluminum	cutter guard
1	3/4 x 3/4 x 1" aluminum	switch mounting plate
1	1/2" hole x 1" blade 3-lip shaper cutter	
1	5/8" dia. x 1 3/8" mild steel	adapter bushing
1	1/2"-20 hex nut	attachment nut
2	#10-32 x 1 1/8" set screws	
12	#2 x 3/8" fh screws	
4	#4 x 3/4" fh screws	
1 each	1/4"-28 x 2 1/4" cap screw with washers and wing nut; 1/4"-28 x 2" cap screw with washers and nut	
4-6	fh screws and nuts to fit motor-flange holes	

brass cut a shim for the heel plate as in Fig. 2D. Drill and countersink #33 holes in the plates for #4 x 3/4-in. fh screws and attach the plates to the bottom of the body. The thickness of the heel-plate shim determines the depth of cut, edge of cutter being adjusted level with bottom of the heel plate. Next, make a cutter guard from 3/64-in. aluminum and attach it to the body with three #2 x 3/8-in. fh screws countersunk flush.

Make the adapter bushing as in Fig. 2G from mild steel on your lathe to fit the cutter bore snugly. Use a standard #20 x 1/2-in. hex nut and saw it off to 3/16-in. thickness to secure the cutter on adapter bushing (Fig. 2I).

Make the toggle-switch mounting plate as in Fig. 2F and, after assembling it to the switch, attach the plate to the plane body with two #2 x 3/8-in. fh screws countersunk flush. Connect switch leads to line and motor leads as in Fig. 2. Solder splices and wrap with electrician's tape.

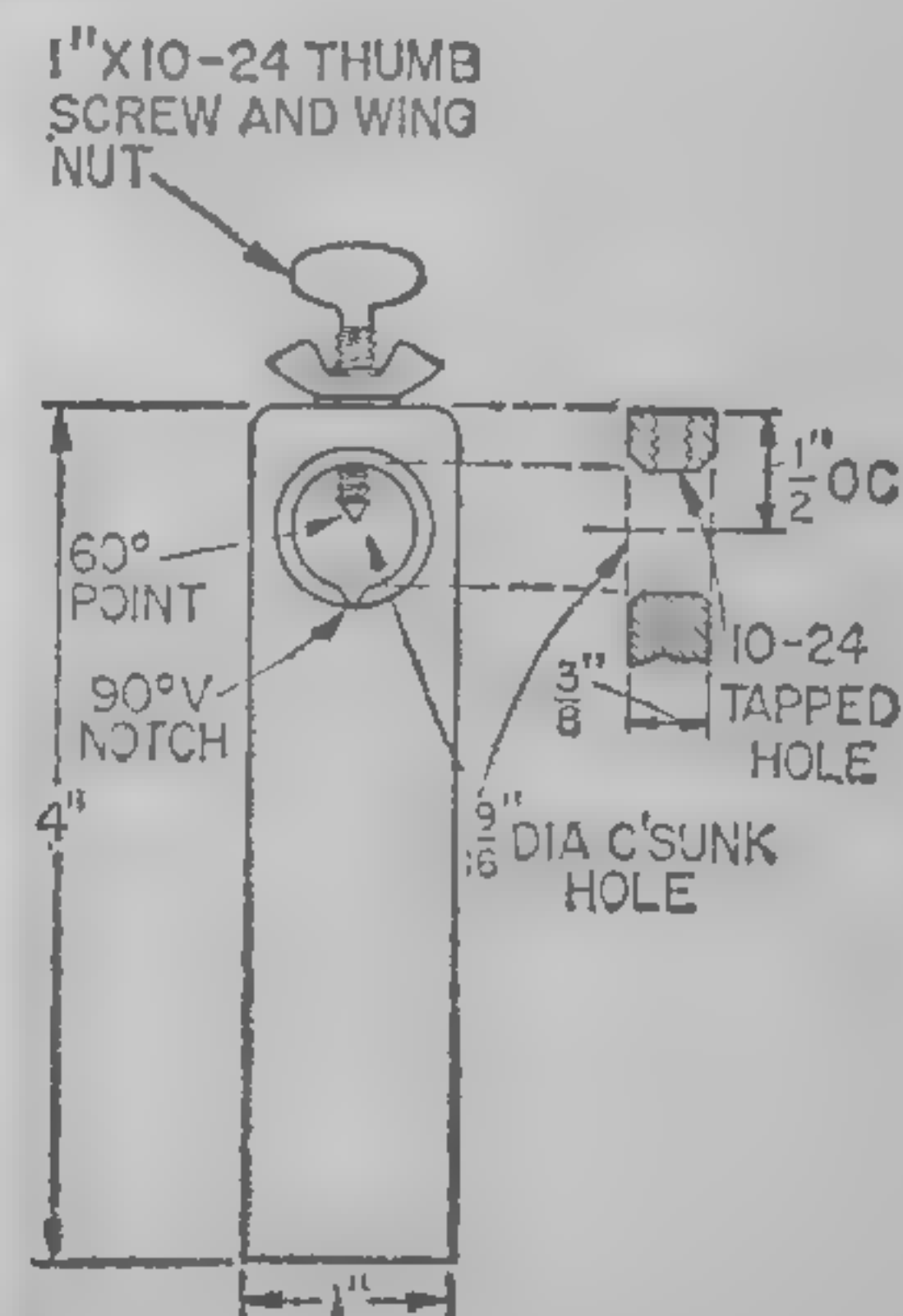
To set up the planer for the 1/32 in. depth of cut, place the heel plate on a flat wooden surface, loosen the wing nut at the front of the plane body and set the edge of one of the cutter blades on the wooden surface. Then tighten the wing nut. When planing the edge of a board, place the toe plate on the surface to be planed and slowly slide the plane across the work.—CARL S. BATES.

Dowel Groover for Good Joints

WHEN building or repairing furniture which has dowel joints, you should use grooved dowels. The grooves provide an escape path for trapped air and glue, lessening the chances of split work.

You can make straight-line grooves in dowel stock using the groover shown in Fig. 1. Follow details in Fig. 2 for making the groover.

To use it, you push the dowel through the hole and the pointed thumb screw, set for a 1/32-in. cut and tightened with a locking wing nut, does the rest. Be sure to make grooves on two sides.—F. HEGEMEYER.





Here's how the hand knurling tool makes easy work of a typically tough job; knurling a small $\frac{3}{16}$ " brass handle. Use plenty of lubricant.

3-Point Knurling Tool

USE THREE rollers to knurl instead of the usual two, and you can add the truly professional appearance of knurling to knobs, instruments, and small parts even if you want to do it without a metal lathe.

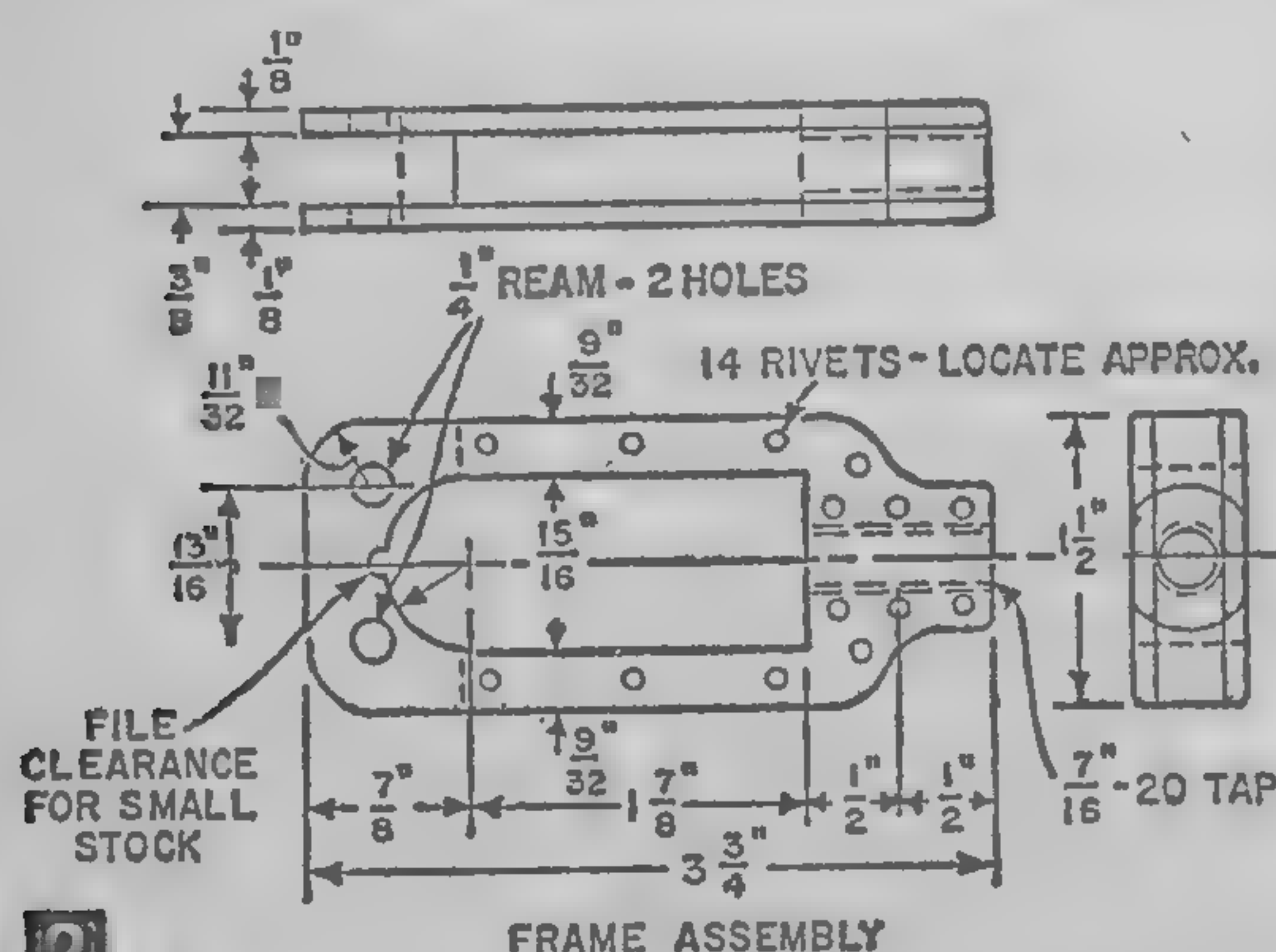
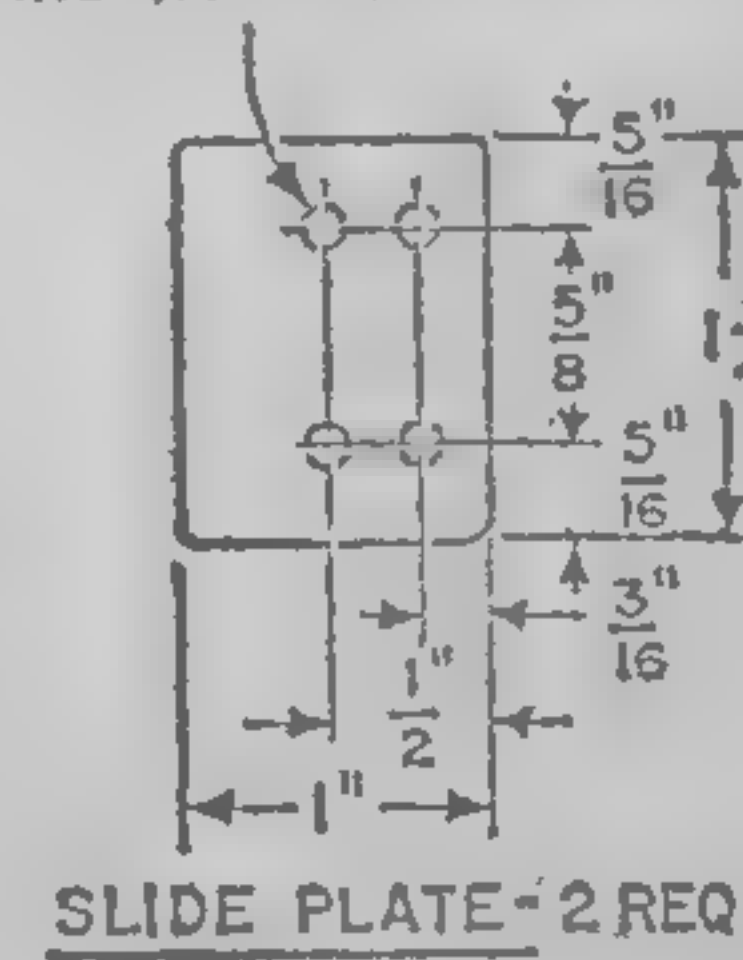
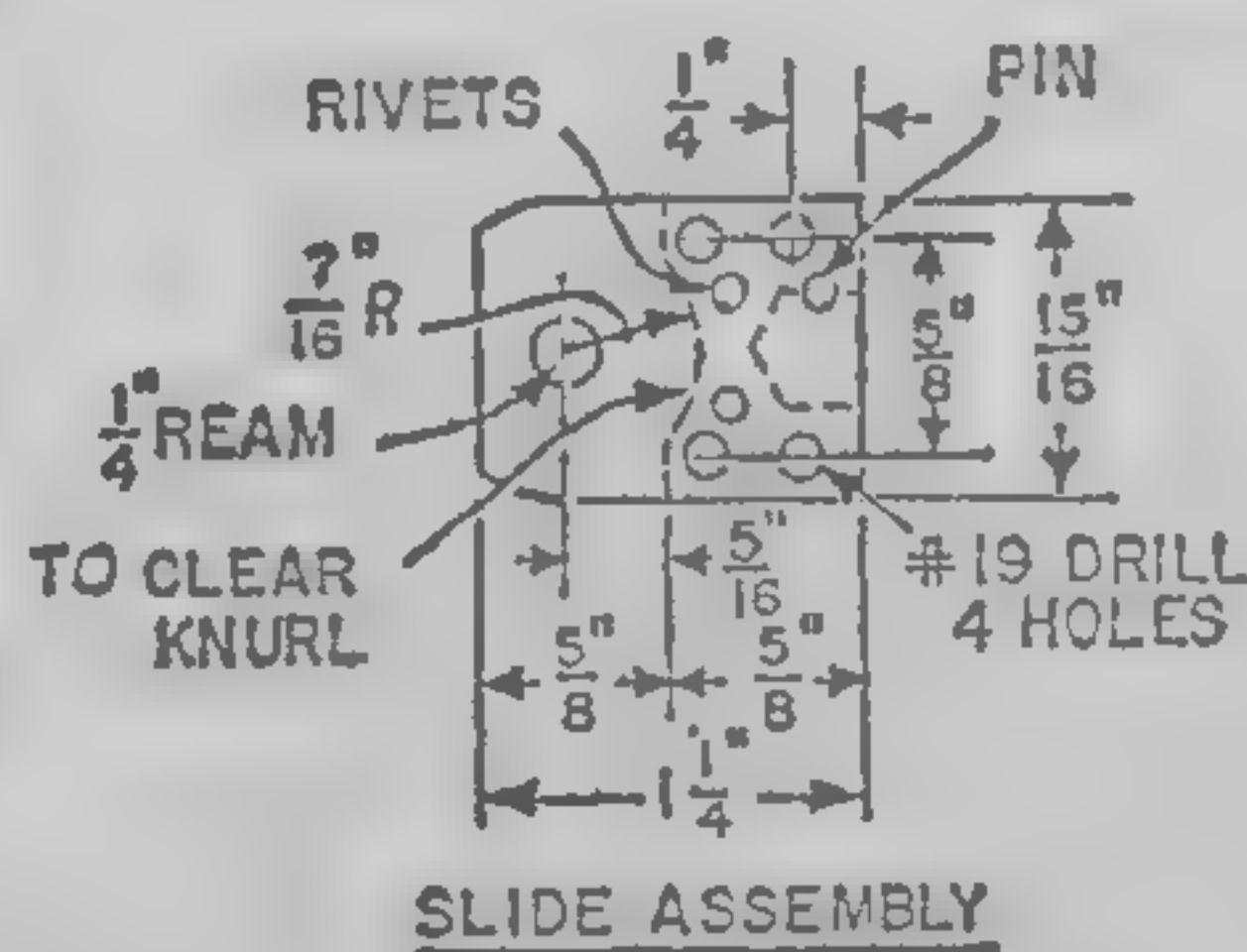
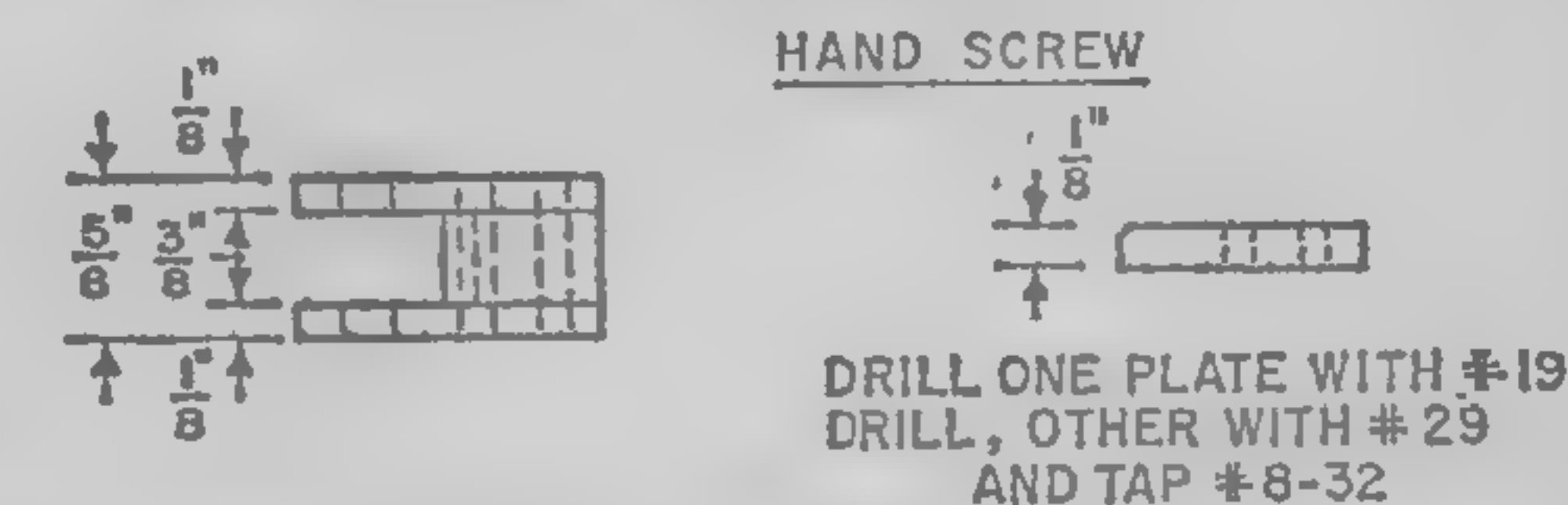
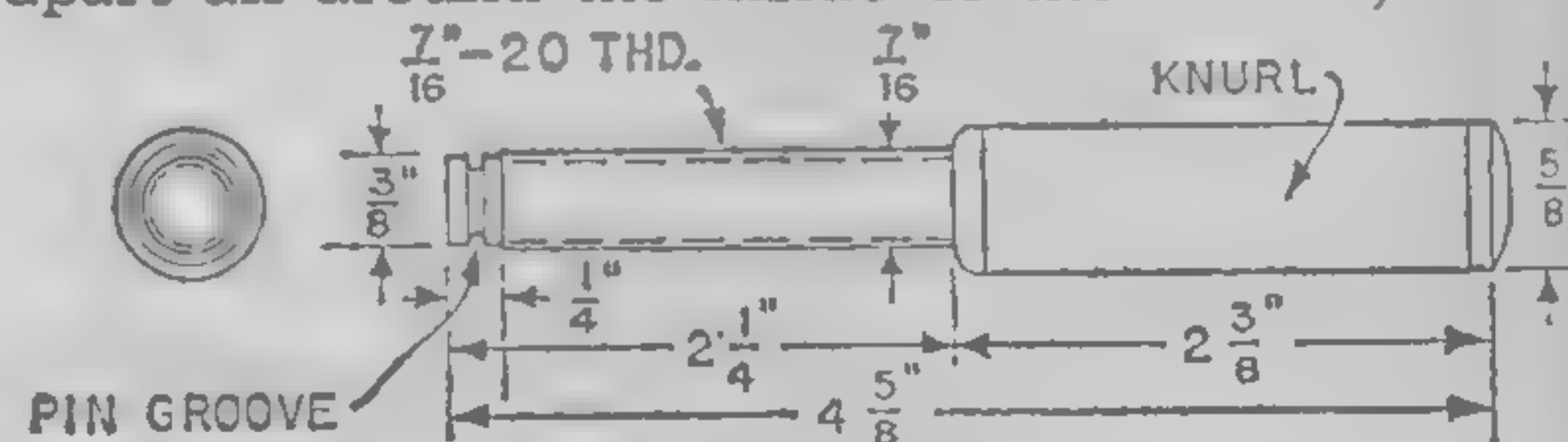
Ordinarily, knurling is done with a lathe tool, that presses two knurling rollers against one side of the revolving work. In knurling, the metal is not cut; rather it is formed, by pressure, and thus it is usually difficult to knurl small parts, especially of soft brass and aluminum. This tool will knurl rods from $\frac{3}{4}$ " down to $\frac{3}{16}$ ". And because it provides its own pressure, you can use it in your drill press, as well as in the lathe. You can even clamp the work in a vise and rotate the tool by hand.

The first step is to buy the knurls, which are available in diamond or straight pattern, from any tool supply house. While they come in coarse, medium, and fine pitch, the fine diamond pattern is your best choice for most small work. If you have a milling machine, or metal cutting band-

saw, the frame can be made of solid stock. Otherwise, Fig. 2 shows how to make it by riveting together three pieces of steel plate.

To make the frame using the latter method, clamp steel plates A, B, and C together, and drill rivet holes in several places. The hole size will depend on the rivets that you have available. They can be made from $\frac{1}{8}$ " cold rolled steel round stock, or you can use #8 finishing nails, which would require a #34 drill. Countersink the holes about $\frac{1}{64}$ " on each side, and rivet the three pieces together temporarily. Now, scribe the layout on one side, and complete all the drilling.

A good method of cutting out the recess for the slide is to drill a series of $\frac{1}{8}$ " holes spaced $\frac{1}{8}$ " apart all around the inside of the outline, with



MATERIALS	
No. Req.	Size and D.
2 pcs	$\frac{1}{8} \times 1\frac{1}{2} \times 3\frac{3}{4}$ " co
1 pc	$\frac{3}{8} \times 1\frac{1}{2} \times 3\frac{3}{4}$ " co
2 pcs	$\frac{1}{8} \times 1 \times 1\frac{1}{4}$ " cold
2 pcs	$\frac{1}{8} \times 1\frac{5}{16} \times 1\frac{1}{4}$ " c
1 pc	$\frac{3}{8} \times \frac{5}{8} \times 1\frac{5}{16}$ " co
1 pc	$\frac{5}{8}$ " dia. x $4\frac{5}{8}$ " col
3	$\frac{3}{4} \times \frac{3}{8}$ " knurling and 2 R.H.
4	#8-32 x $\frac{7}{8}$ " fi
	$\frac{1}{8}$ " rod or nails to
1	$\frac{3}{16}$ " steel bearing

the holes not quite to knock out the center mounted grinding wheel. A press is also handy for

Remove the excess from the frame, by drilling three pieces apart and to clear the knurls.

After reassembling them permanently to the hole, peening them down, the sunk ends of the hole frame smooth, and the lathe and drill and tap

Construction of the

Your

BENDING

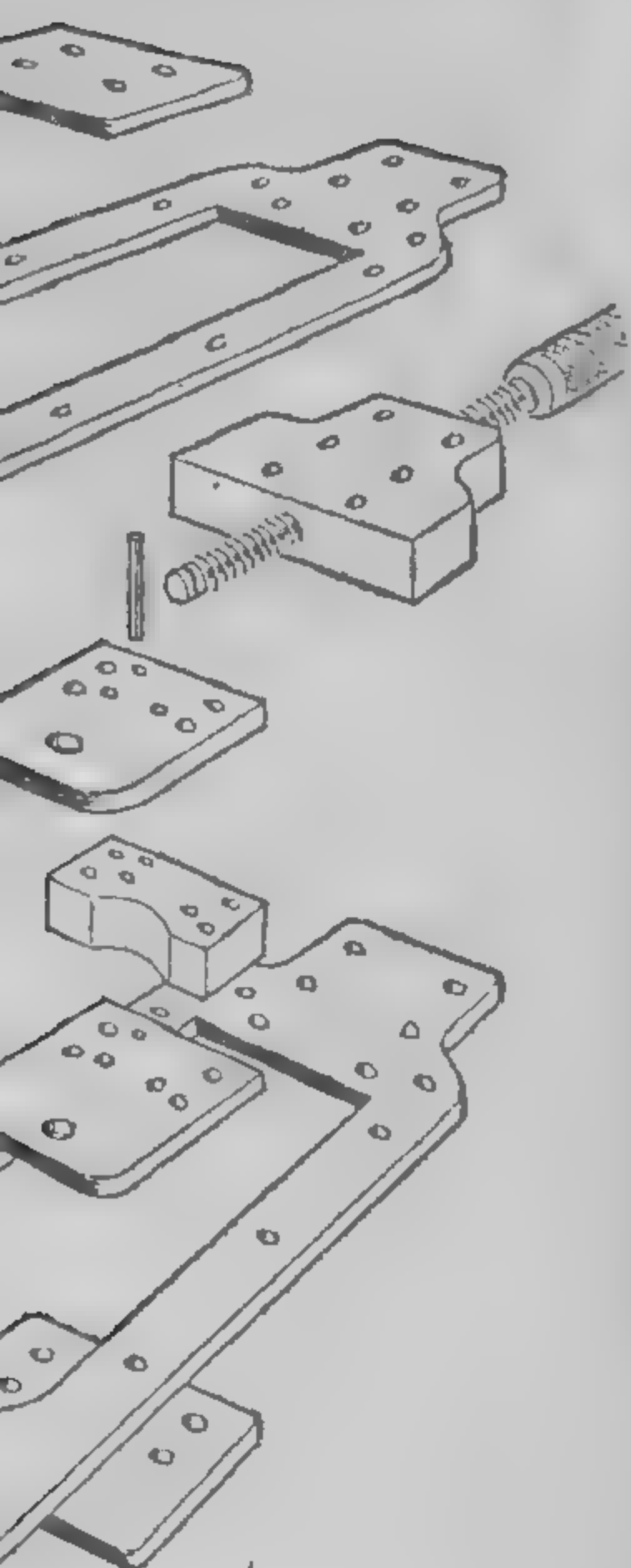
SMALL channels, models and electrical boxes can be quickly from light gauge bending brake

To bend any of the simply clamp the metal the bending line. Then ing plier, and bend which is nailed to the give you the necessary

The brake length is practical for most small working with very "throat" or maximum the distance between

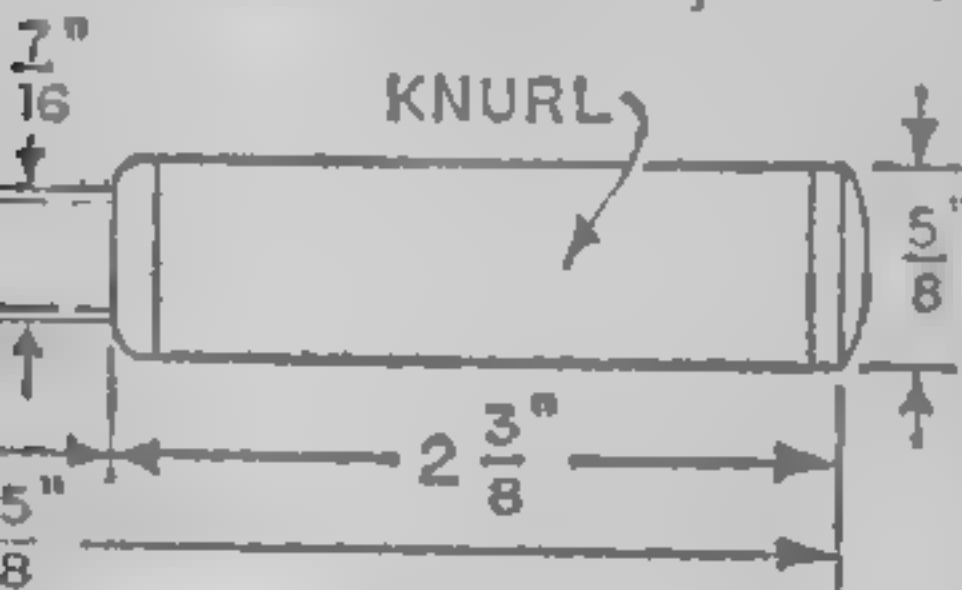
The gripper is made iron. Either file the ends them down with heavy disc sander, working gently be dangerous to the fingers iron and the underplate bolts. Countersink the You can add a refinement the underplate holes to

To obtain precise bend metal with a scribe, along the edge of your grades of sheet metal, do not take a sharp 90° bend you plan to bend such a radius on the edge of

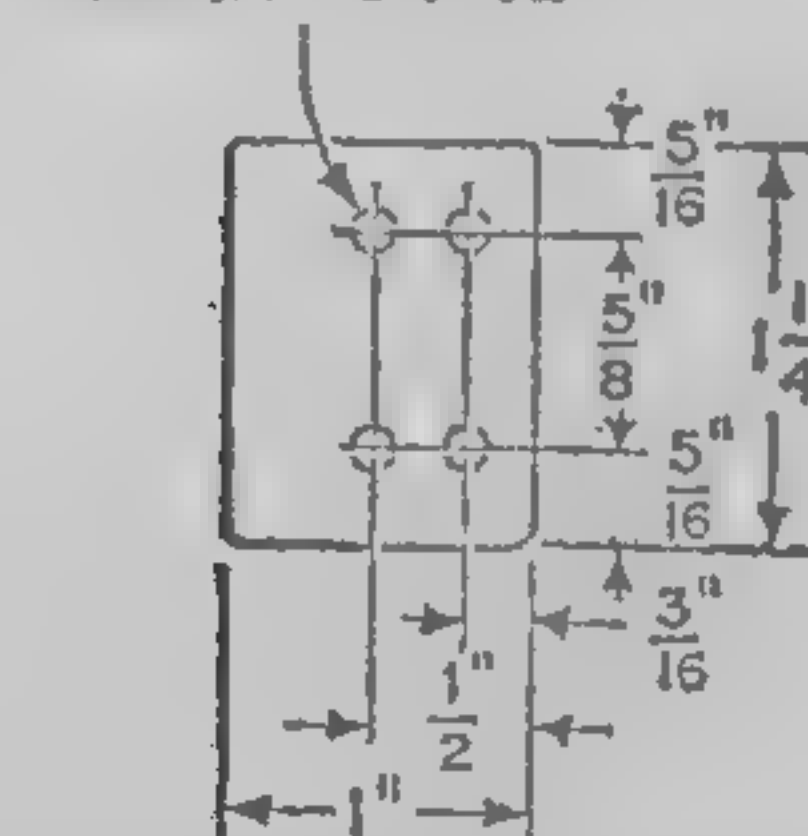


of solid stock. Other-
to make it by riveting
steel plate.
ing the latter method,
d C together, and drill
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t you have available.
1/8" cold rolled steel
se #8 finishing nails,
34 drill. Countersink
ch side, and rivet the
porarily. Now, scribe
complete all the drill-

g out the recess for the
1/8" holes spaced 1/8"
e of the outline, with



ONE PLATE WITH #19
L, OTHER WITH #29
AND TAP #8-32



SLIDE PLATE-2 REQ.

MATERIALS LIST—KNURLING TOOL			
No. Req.	Size and Description		
2 pcs	$\frac{1}{8} \times 1\frac{1}{2} \times 3\frac{3}{4}$ " cold rolled steel	} Finished size	
1 pc	$\frac{3}{8} \times 1\frac{1}{2} \times 3\frac{3}{4}$ " cold rolled steel		
2 pcs	$\frac{1}{8} \times 1 \times 1\frac{1}{4}$ " cold rolled steel		
2 pcs	$\frac{1}{8} \times \frac{15}{16} \times 1\frac{1}{4}$ " cold rolled steel		
1 pc	$\frac{3}{8} \times \frac{5}{8} \times 1\frac{5}{16}$ " cold rolled steel		
1 pc	$\frac{5}{8}$ " dia. x $4\frac{5}{8}$ " cold rolled steel	}	
3	$\frac{3}{4} \times \frac{3}{8}$ " knurling rolls—1 R.H. and two L.H. or 1 L.H. and 2 R.H.		
4	#8-32 x $\frac{7}{8}$ " fill. hd. machine screws		
	$\frac{1}{8}$ " rod or nails for rivets		
1	$\frac{3}{16}$ " steel bearing ball		

the holes not quite touching the layout line. Then knock out the center, and finish by filing. A 3/4" mounted grinding wheel chucked in the drill press is also handy for finishing the recess.

Remove the excess metal on the screw end of the frame, by drilling and filing. Then, take the three pieces apart and cut 3/4" off the center piece to clear the knurls.

After reassembling the three pieces, fasten them permanently together with rivets in each hole, peening them down well into the countersunk ends of the holes. File both sides of the frame smooth, and then chuck the frame in the lathe and drill and tap the threaded screw hole.

Construction of the slide assembly is similar to

the frame, but it consists of five pieces of steel plate, with the outside slide plates held by screws. Rivet the center portion together, and then clamp the two side plates to it for drilling with the #29 drill. Then remove one side plate, and enlarge the holes in it and the slide with a #19 drill, to take the 8-32 screws. Tap 8-32 holes in the other side plate.

Turn the hand screw on the lathe, and include a small center in its end for the 3/16" thrust ball. With the screw installed in your frame and slide, drill the pin hole through the slide to locate the groove, which is turned on the lathe.

The tool is now ready for final assembly. Knurls have 1/4" ground holes, which permit them to turn freely on 1/4" pins, which you can make from unhardened drill rod. Countersink the pin holes in the frame slightly, and peen the pins lightly to hold them in place. They can be easily punched out, when you want to change knurls.

The tool is used by clamping it on the work, and slowly pushing it along as the work rotates, with plenty of oil to act as cutting and heat-removing lubricant. You can also knurl small head screws and knobs, simply by clamping down the tool and revolving it, while the work is held in a vise or stationary chuck.—T. L. STALKER.

Your tool box would welcome this Hand-Powered

BENDING BRAKE

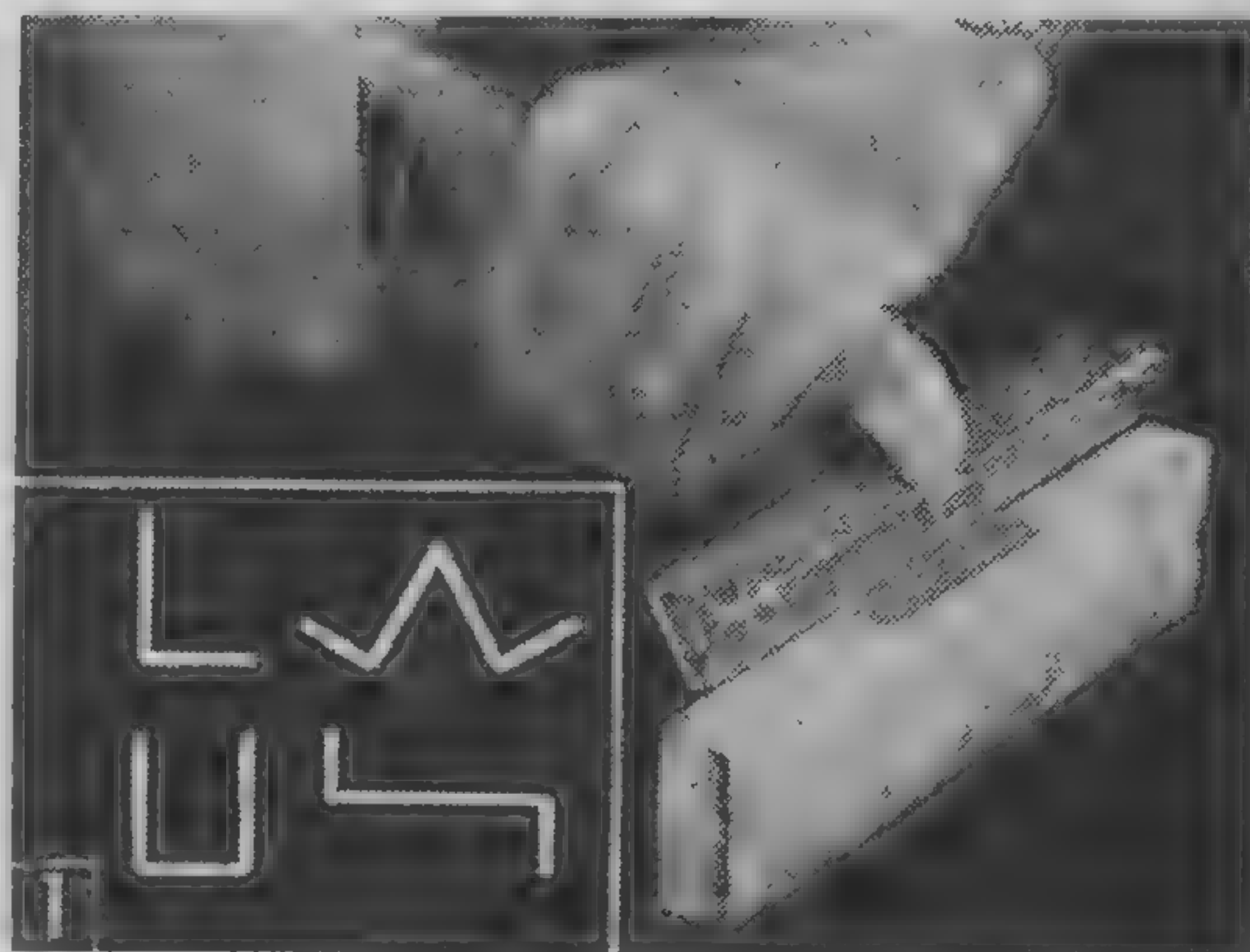
SMALL channels, angles, bends, and parts for models and electronic chassis can be made quickly from light sheet metal with this accurate bending brake (Figs. 1 and 2).

To bend any of the shapes shown in Fig. 1A simply clamp the metal tightly in the brake along the bending line. Then hold the brake in a clamping plier, and bend the metal against a block which is nailed to the bench or held in a vise, to give you the necessary clearance for the handle.

The brake length is optional, 6 to 8 inches is practical for most small work, longer if you are working with very light sheet metals. The "throat" or maximum size of bend is limited by the distance between the two clamping screws.

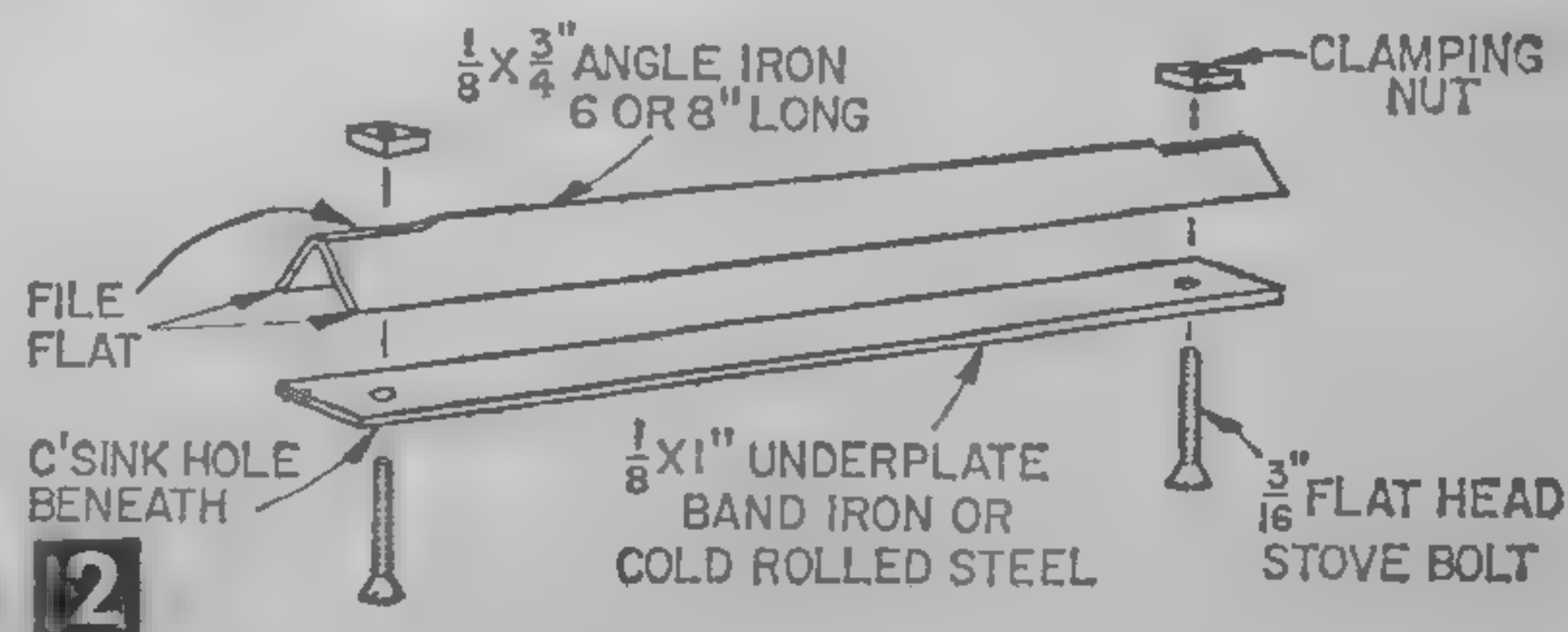
The gripper is made of a piece of 3/4 inch angle iron. Either file the edges flat (Fig. 2), or sand them down with heavy abrasive cloth on a power disc sander, working gingerly, since a snag could be dangerous to the fingers. Then drill the angle iron and the underplate to take two 3/16 in. stove bolts. Countersink the holes in the underplate. You can add a refinement to the design by tapping the underplate holes to keep bolts from turning.

To obtain precise bends, first mark your sheet metal with a scribe, and then clamp it exactly along the edge of your bender. Some harder grades of sheet metal, particularly aluminum, will not take a sharp 90° bend without rupturing. If you plan to bend such metal, file or grind a small radius on the edge of the gripper.



Bending pressure should be applied firmly and evenly, and metal should be gripped tightly in the "throat" of the bender.

The basic design of the brake can be made considerably larger with angle iron up to 2 inches. Then instead of bending with the plier-wrench, clamp the bender and the sheet metal in a vise and hammer with a block of wood to make the bend.—CARL S. BATES.

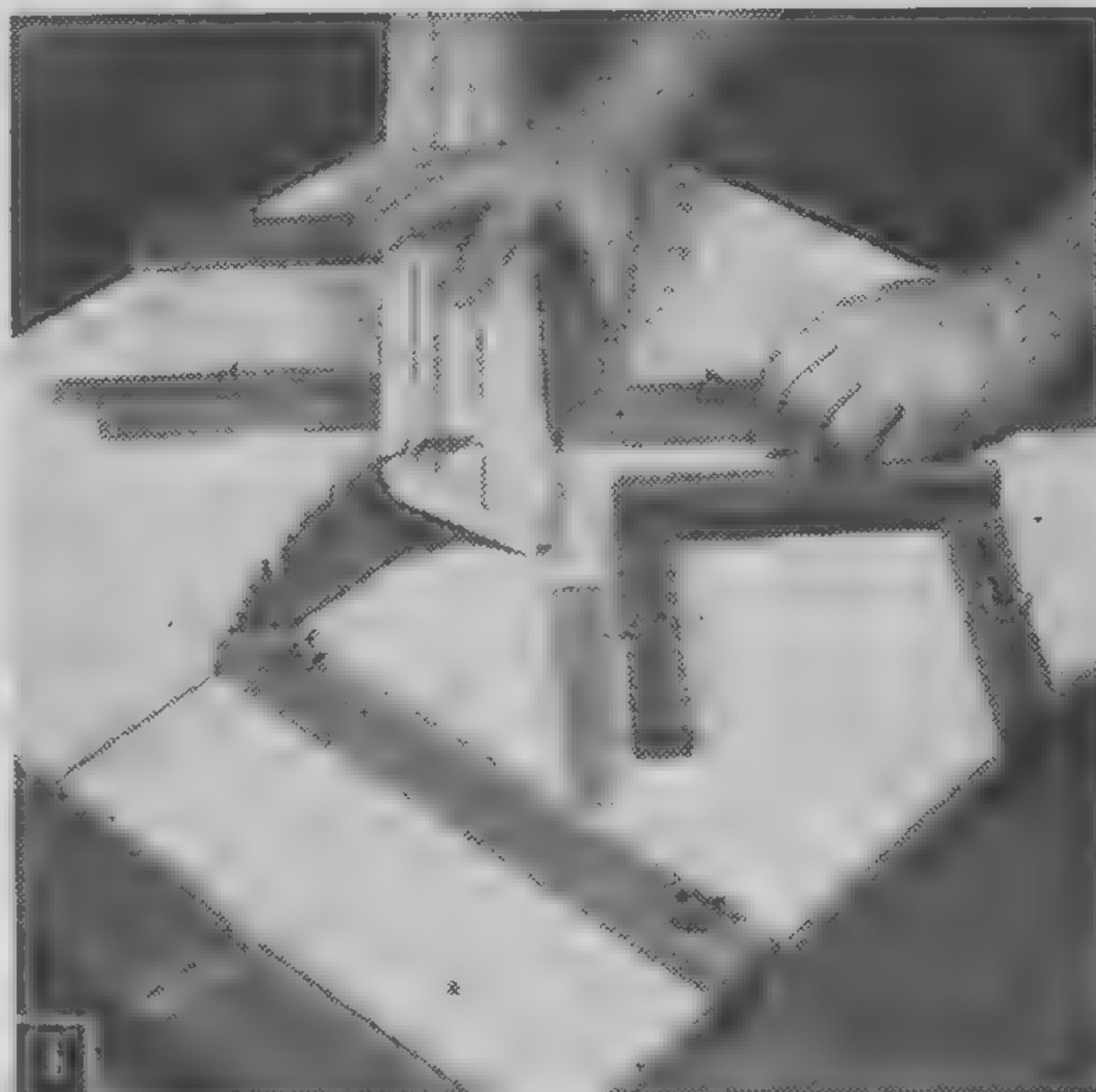


Fixture Makes Compound-Angle Cutting Easy

THIS circular saw attachment frees you of the trouble of figuring out the angle of blade tilt and miter setting.

These are problems you encounter when sawing a desired compound-angle cut for picture frame or shadow box stock.

To cut a compound miter, first place the molded frame stock against the 45° fence, tilt the stock at the desired angle as in Fig. 1 and make the cut with the saw blade in the vertical position by sliding the fixture across the saw table. The stock is held at the desired angle of tilt by the

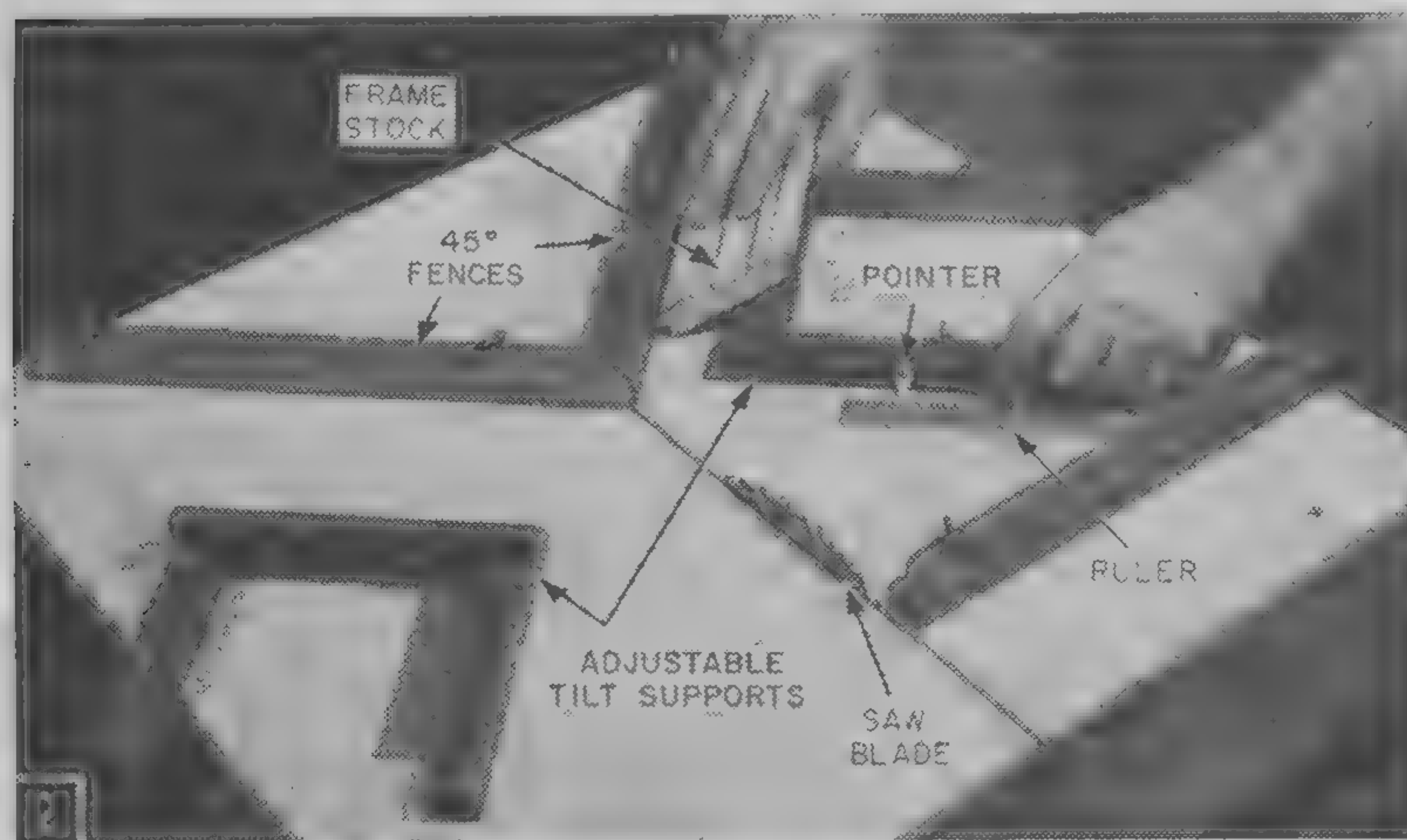


Mating compound-angle cuts are made on adjacent pieces of frame stock by using fixture supports at the right of the saw blade for one piece and supports at the left for the other.

TABLE A 8" BLADE		
Having 1 1/2 in. depth of cut above fixture base		
Angle of tilt	Allowable width of stock (in inches)	Distance of tilt unit from fence
5°	4 5/8	4 1/4
10°	4 1/8	3 1/2
15°	2 7/8	2 1/4
20°	2 1/4	1 5/8
25°	1 7/8	1 1/4
30°	1 5/8	1
35°	1 1/2	13/16
40°	1 1/16	11/16
45°	1 3/8	9/16

10" BLADE		
Having 2 1/2 in. depth of cut above fixture base		
Angle of tilt	Allowable width of stock (in inches)	Distance of tilt unit from fence
5°	4 5/8	4 1/4
10°	5 1/8	4 1/4
15°	6 3/4	4 1/4
20°	5 1/8	2 15/16
25°	4 1/4	2 1/16
30°	3 5/8	1 1/2
35°	3 1/4	1 1/8
40°	3	13/16
45°	2 3/4	9/16

The allowable width dimensions applies to frame stock having an overall thickness of 3/4 in. Thinner stock than this permits an increase in the allowable width and decreases where the stock exceeds the 3/4-in. thickness. Depth of cuts greater than indicated for the above blades also increases the allowable width of frame stock which can be used.



After setting the adjustable tilt support to hold the frame stock at the desired angle on one side of the fixture, set the tilt support on the other side of the saw blade so that both pointer settings on the scales read the same.

adjustable tilt support unit (Fig. 2). Table A lists tilt support settings for various stock thicknesses and widths for use with 8 and 10 in. circular saws.

Making The Fixture. Following the dimensions given in the Materials List, cut the fixture base and table slot bars to size. Since the slot bars must slide smoothly in the slots on your table

saw, check the dimensions given for the slot bars we used to make certain they will fit your saw table. Assemble by placing the slot bars in the saw table slots and center the fixture base over the lowered saw blade and on top of the slot bars. Use glue and brads to fasten slot bars to underside of fixture base. Then raise the saw blade and cut the fixture base to within 6 in. of the rear side as in Fig. 3.

Make the three fences (Fig. 3A, B and C) and bore the pivot holes and 3/8 x 3/4-in. slots in them. To locate the fences, bore the pivot holes in the

fixture base at the mentioned points (Fig. 3) and mount the fence at a 45° angle in relation to the saw blade. Also mark the hole location for the slots. Counterbore all holes on the underside of the fixture base for recessing bolt heads.

After cutting the slots in the arms of the tilt support units (Fig. 3) attach the cross-pieces to the arms with glue and nails. Be sure the nails are set back far enough (Fig. 3E) to clear the saw blade when cutting the 45° bevel on the front ends of the units. To locate the holes in the base for the units place the beveled edge against the fence as shown to the left in Fig. 3, and mark the location at the far end of the slots.

To accurately position the tilt support unit

MATERIALS LIST—COMPOUND

No. Req'd	(all dimensions in inches)	Description
1	1/2 x 24 x 24 douglas	
2	3/8 x 3/4 x 24 hardwood	
2	3/4 x 1 1/4 x 15 hardwood	
1	3/4 x 1 1/4 x 12 hardwood	
4	3/4 x 1 1/4 x 7 3/4 hardwood	
2	3/4 x 2 x 7 1/2 hardwood	
10	1/4 x 1 1/2 carriage bolts	
		nuts & washers
2	3/8 x 3/4 x 24 gage sheet	
6	#4 x 3/8 rh screws	
2	6 in. metal or plastic	rod to read from level



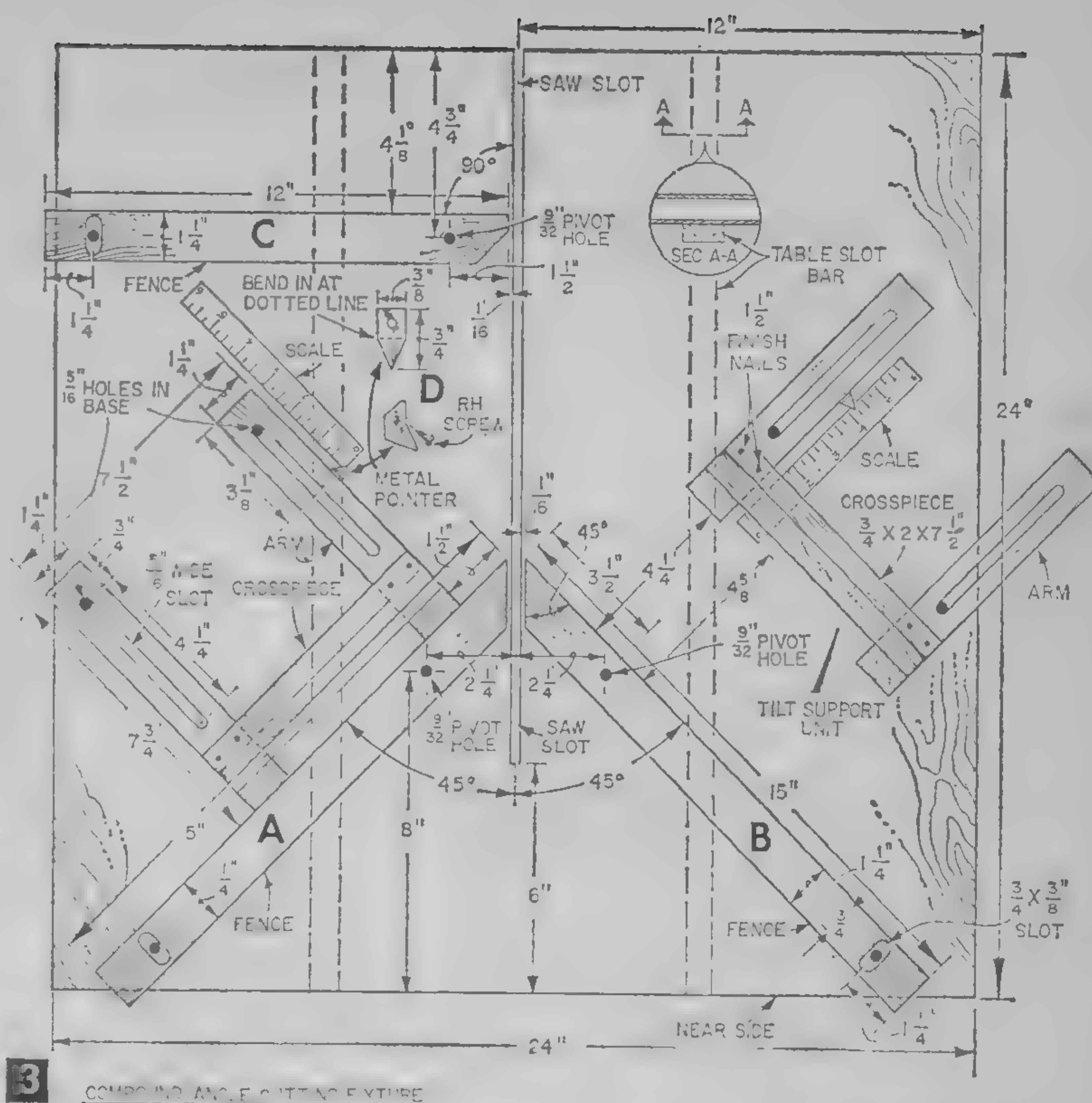
Check the accuracy of the holding test-cut pieces against the gap (if any) at the end

Fig. 2). Table A various stock thicknesses 8 and 10 in., circular. Measure the dimensions of the fixture base and the slot bars. Since the slot bars are 1/2 in. wide, check the dimensions given for the slot bars. Use the saw to make the slot bars. They will fit your table. Assemble by gluing the slot bars in the table slots and the fixture base. The lowered saw and on top of the bars. Use glue and to fasten slot bars on the underside of fixture. Then raise the saw and cut the fixture to within 6 in. of the side as in Fig. 3. Use the three fences (A, B and C) and the pivot holes and 1/2 in. slots in them. Use the fences, bore the pivot holes in the

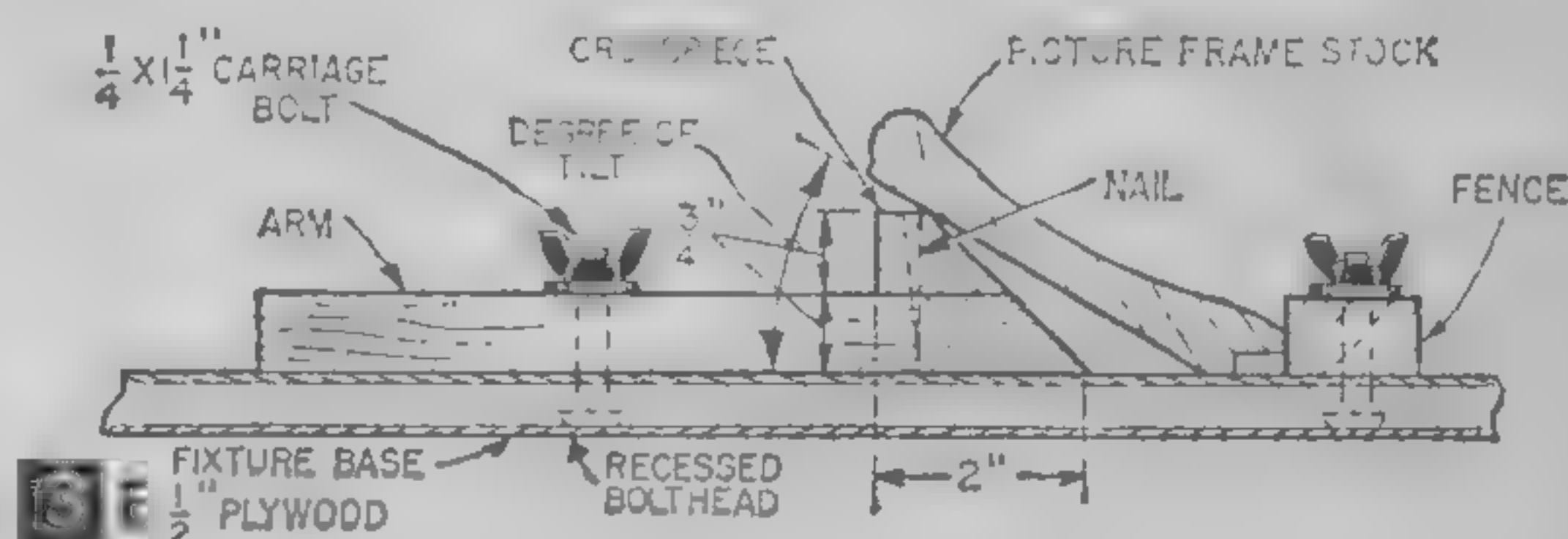
fixture base at the dimensioned points (Fig. 3) and mount the fences at a 45° angle in relation to the saw blade. Also mark the hole locations for the slots. Counter-bore all holes on the underside of the fixture base for recessing the bolt heads.

After cutting the slots in the arms of the tilt support units (Fig. 3), attach the cross-pieces to the arms with glue and nails. Be sure the nails are set back far enough (Fig. 3E) to clear the saw blade when cutting the 45° bevel on the front ends of the units. To locate the holes in the base for the units, place the beveled edge against the fence as shown to the left in Fig. 3, and mark the location at the far end of the slots.

To accurately position the tilt support units,



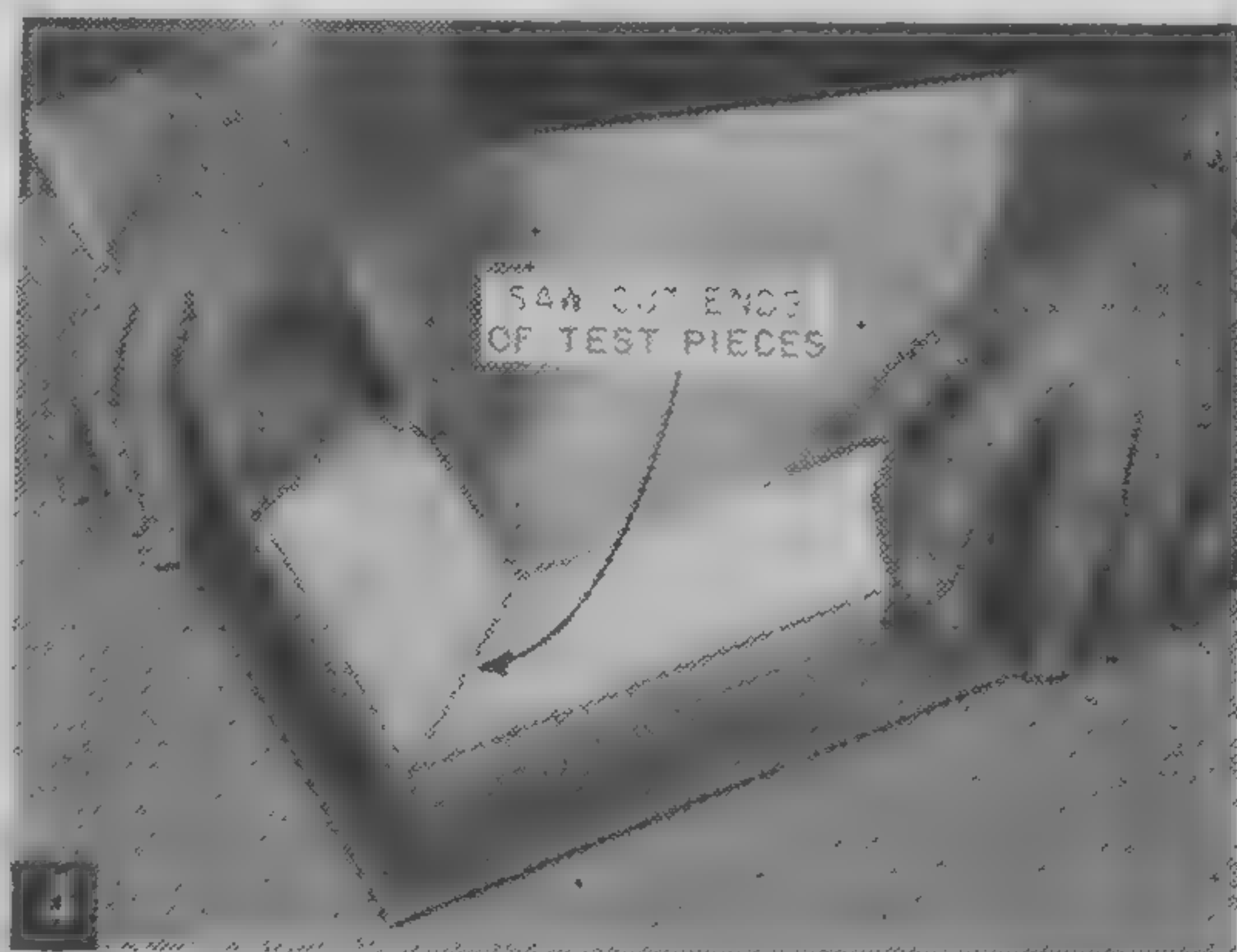
MATERIALS LIST—COMPOUND ANGLE CUTTING FIXTURE		
(all dimensions in inches)		
No. Req'd	Description	Use
1	$\frac{1}{2}$ x 24 x 24 douglas fir plywood	fixture base
2	$\frac{3}{8}$ x $\frac{3}{4}$ x 24 hardwood	table slot bars
2	$\frac{3}{4}$ x $1\frac{1}{4}$ x 15 hardwood	fences
1	$\frac{3}{4}$ x $1\frac{1}{4}$ x 12 hardwood	fence
4	$\frac{3}{4}$ x $1\frac{1}{4}$ x $7\frac{3}{4}$ hardwood	slotted arms
2	$\frac{3}{4}$ x 2 x $7\frac{1}{2}$ hardwood	crosspieces
10	$\frac{1}{4}$ x $1\frac{1}{2}$ carriage bolts, with wing nuts & washers	lock bolts
2	$\frac{3}{8}$ x $\frac{3}{4}$ x 24 gage sheet metal	pointers
6	#4 x $\frac{3}{8}$ rh screws	pointer fasteners
2	6 in. metal or plastic scale, graduation to read from left to right	scales



drill two $\frac{1}{8}$ -in. holes in the 6 in. scales and fasten them to the base as in Fig. 3 with #4 x $\frac{3}{8}$ rh screws. Make two sheet-metal pointers as in Fig. 3D and fasten them to the sides of the tilt units and use as pointers to indicate the position of tilt units in respect to the A and B fences.

To adjust the A and B fences to make true 45° cuts, take two 2½ x 12-in. scrap boards and cut the ends at a 45° angle using the A fence. Then check the cut ends with a 2-ft. square as in Fig. 4. Discrepancies can be corrected by loosening the bolt at the slotted end of the fence and changing the angle of the fence as necessary. Repeat the procedure until a perfect fit at the cut ends of the scrap pieces is obtained. Adjust fence B as you did fence A. Fence C, which is used as a general cut-off fence, is set at a 90° angle with the blade.

Coat the entire unit with linseed oil to reduce warping and apply paraffin to the table slot bars to ease the sliding action of the fixture as you push it across the circular saw table. Remember to slide the fixture back clear of the saw blade when removing it.—FRANK HEGEMEYER.



Check the accuracy of the A and B fence positions by holding test-cut pieces against a metal square and noting the gap (if any) at the ends of the 45° saw-cut edges.

Screwdriver Attachment Has Screw Slot Finder



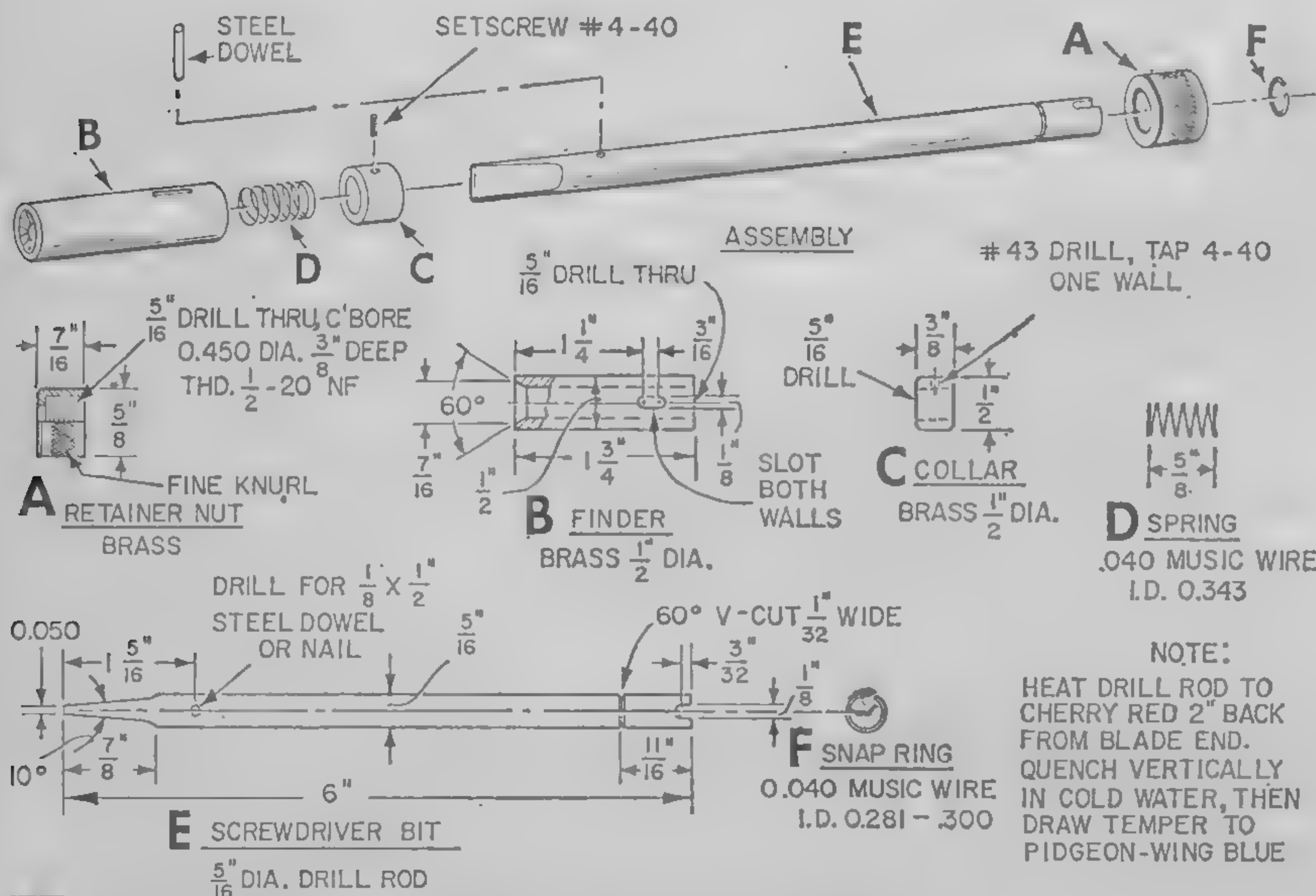
Screwdriver attachment in operation. Note finder has located screw head, and long bit permits speed reducer to clear 6 in. backboard.

COUPLED to a Versamatic speed reducer on a $\frac{1}{4}$ -in. electric drill as in Fig. 1, the screwdriver attachment will automatically position the screwdriver bit in the screw-head slot and hold it there until the screw is driven.

In use, the finder (Fig. 2) is placed over the screw-head (screws must be previously tapped in place with a hammer), and, with a slight driving pressure, the bit will engage the slot during the first half turn. The spring-loaded finder will then prevent the screwdriver bit from slipping out of the screw slot and marring the work, and, being spring loaded, a flat-headed screw may be driven flush with the work surface. The 6-in. length of the bit will enable you to drive screws in hard-to-reach places too.

The retaining nut, finder and collar (Figs. 2A, B & C) are all made from a $\frac{5}{8}$ x 4-in. brass rod (see Materials List). Chuck the rod in your lathe's 3-jaw chuck, and turn and drill the collar and finder first. Then cut off the collar, and chamfer the finder. Cut off the finder, and use balance of rod for making the retainer nut. Drill the two $\frac{1}{8}$ -in. holes through both walls of the finder, and file the slot between them to make a sliding fit with a steel dowel or nail. Drill and tap the collar for a #4-40x $\frac{1}{8}$ -in. socket setscrew. Make the spring and snap ring from a 2-ft. length of .040-in. dia. music wire, or purchase a spring at a hardware store and cut off coils to size.

Next make the screwdriver from a $\frac{5}{16}$ -in. dia. x 6-in. piece of drill rod or tool steel. The length and bit tip thickness can vary to suit the job requirements. The bit tip thickness is .045-in. for a #6 screw, .050-in. for a #8 screw, and .055-in. for a #10 screw. Chuck rod in lathe and turn a V-shaped groove for snap ring. Grind or file bit tip to required thickness, and drill hole for press fitting steel dowel



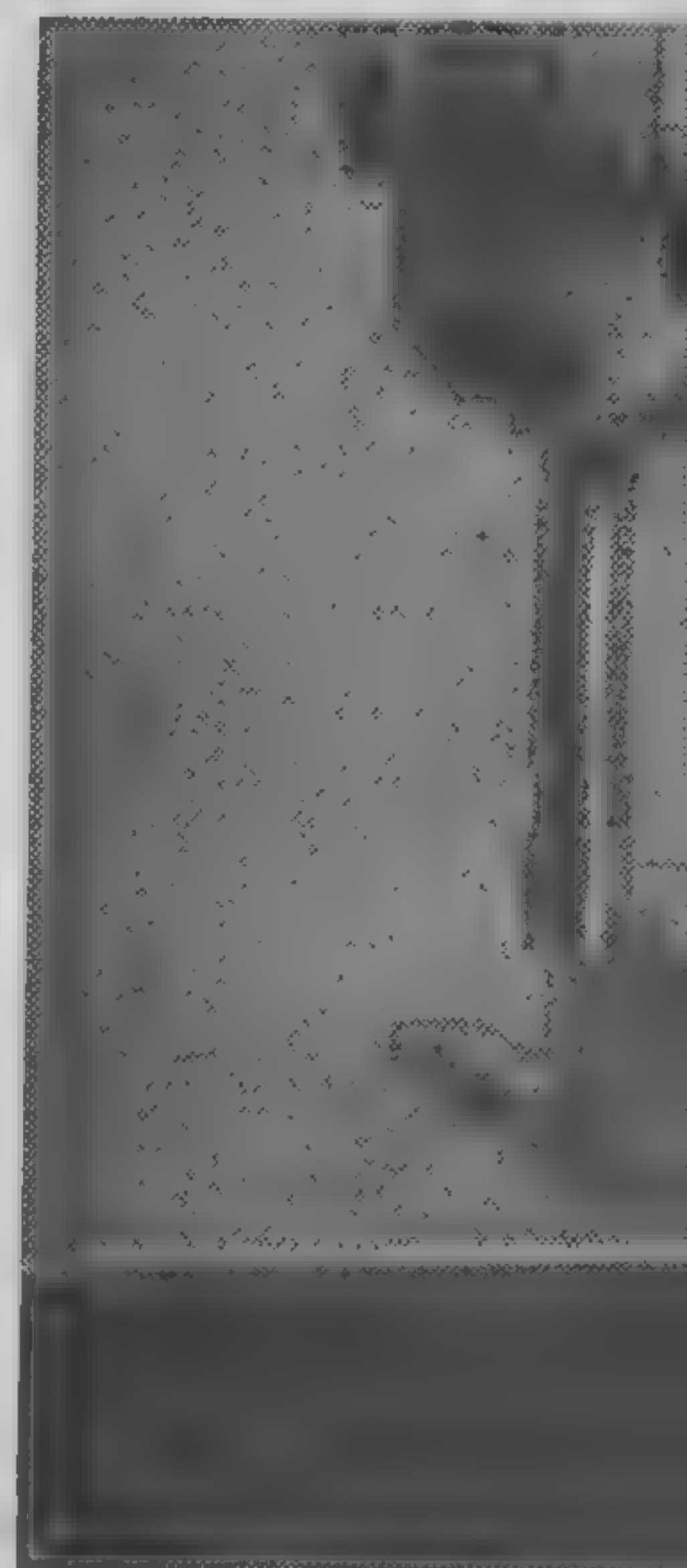
2 SCREWDRIVER AND FINDER FOR VERSAMATIC SPEED REDUCER

Amt.	Description
1	$\frac{5}{16}$ x 6" drill rod
1	$\frac{5}{8}$ x 4" brass rod
2 ft.	.040 music wire
1	4-40 x $\frac{1}{8}$ " socket h

or nail. Drill $\frac{1}{8}$ -in. hole out notch.

To harden the bit, heat bit tip to 2 in. back of cold water, holding the work warping. Remove the work from emery cloth. To temper, heat point 2 in. back on work, note the metal as it changes colors will be shaded

Edgefin



WITH this edgefin, a milling machine with milling table and machine spindle can be placed over the work and used for drilling or milling from the edge. With the accuracy of the tool.

Chuck a $\frac{1}{2}$ in. dia. x 2 in. polished drill rod in a lathe. Turn the shank to $\frac{1}{2}$ in. dia. x 2 1/2 in. as shown. Turn tailstock center for support. Turn moderate, constant pressure hole through the length of the rod. Drill holes $\frac{5}{16}$ in. in dia. x 1 in. deep in two at the $\frac{3}{4}$ -in. dia. end) and take light

Has Finder

automatic speed reducer drill as in Fig. 1, the bit will automatically find the screw-head center. The spring-loaded bit in the screw-head will engage the slot in the screw. The spring-loaded bit will enable you to reach places too.

2) is placed over the bit and collar (Figs. 1 and 2). Chuck the rod in your lathe and drill the collar hole. Cut off the collar, and use the finder, and use the retainer nut. Drill through both walls of the hole to make a hole. Drill a #4-40x1/8-in. socket screw and snap ring from a music wire, or purchase and cut off coils to size.

Next make the screwdriver from a 5/16-in. dia. x 6-in. piece of drill rod or tool steel. The length and bit tip thickness can vary to suit the job requirements. The bit tip thickness is .045-in. for a #6 screw, .050-in. for a #8 screw, and .055-in. for a #10 screw. Chuck rod in lathe and turn a V-shaped groove for snap ring. Grind or file bit tip to required thickness, and drill hole for press fitting steel dowel

MATERIALS LIST—SCREWDRIVER ATTACHMENT		
Amt.	Description	Use
1	5/16 x 6" drill rod or tool steel	bit
1	5/8 x 4" brass rod	nut, finder and collar
2 ft.	.040 music wire	spring, snap ring
1	4-40 x 1/8" socket head setscrew	collar

or nail. Drill 1/8-in. hole at tail end of rod and file out notch.

To harden the bit, heat to a cherry red from bit tip to 2 in. back on the rod, then quench in cold water, holding the rod vertically to prevent warping. Remove discoloration from rod with emery cloth. To temper the bit, reheat at a point 2 in. back on the rod from the tip and note the metal as it takes on color. The first colors will be shades of brown followed by

shades of blue which will flow toward the bit tip. When a pigeon blue color reaches the bit tip, quench the bit in cold water. Repolish the rod to a bright color with emery cloth.

To assemble the parts, slide the collar, spring and finder onto the bit with chamfered end of the finder towards the bit tip. Drive the steel dowel or nail through the finder slots and hole in bit. Slide the collar back towards the finder until spring is compressed slightly, then tighten the collar onto the bit with the setscrew. Spring compression can be varied by adjusting the collar. Slide the retainer nut on bit with threaded end towards bit tail, and place on snap ring.

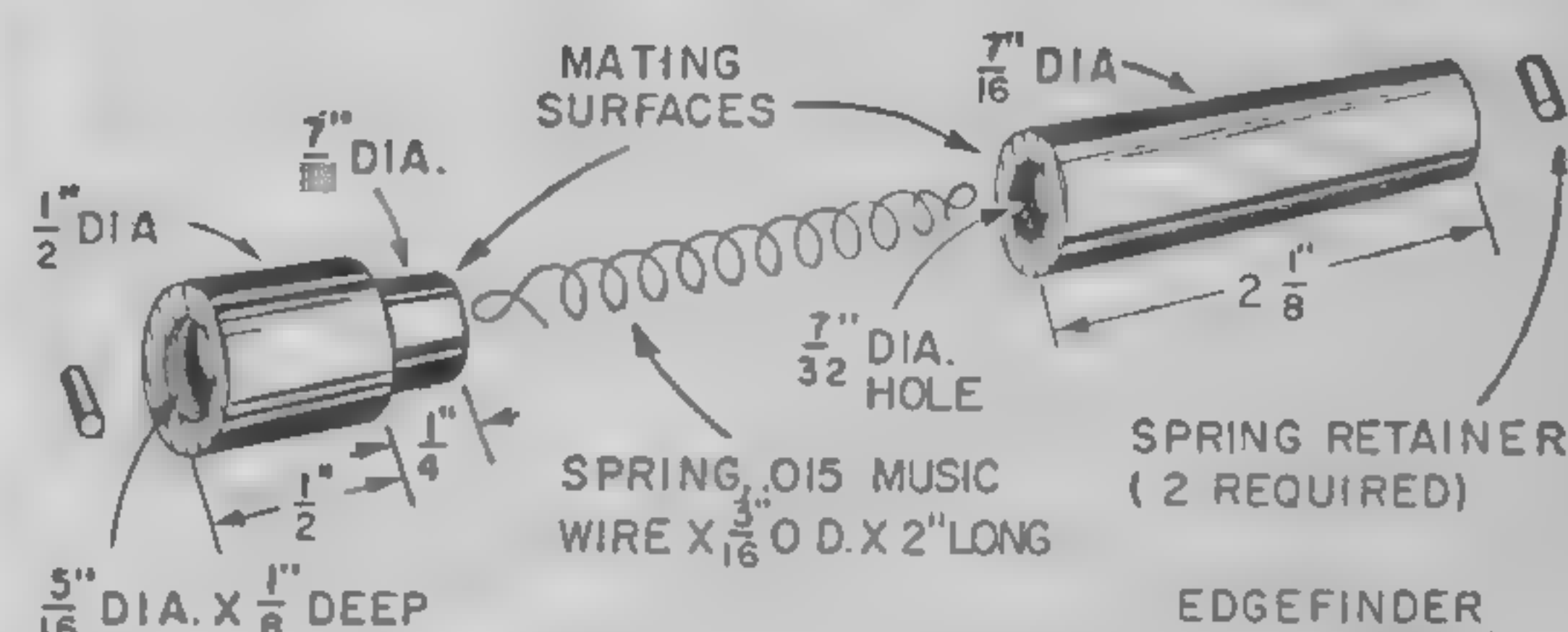
The tool is now complete, and after attaching to the Versamatic speed reducer with the retainer nut, is ready for use.—C. T. ALLEN.

Edgefinder for Accurate Machining



WITH this edgefinder chucked in your milling machine or drill press equipped with milling table, the center of the machine spindle can be quickly and accurately placed over the work edge, providing a starting point for drilling or milling at a precise distance from the edge. With normal care in machining, the accuracy of the tool is within .001 of an inch.

Chuck a 1/2 in. dia. x 3-in. piece of ground and polished drill rod in a lathe and center drill both ends. Turn the shank end of the rod to 7/16 in. dia. x 2 1/2 in. as shown in the drawing, using the tailstock center for support. With cutting oil and moderate, constant pressure, drill a 7/32-in. dia. hole through the length of the rod. Drill two end holes 5/16 in. in dia. x 1/8 in. deep. Cut the drill rod in two at the 3/4-in. mark (from the 1/2-in. dia. end) and take light facing cuts on both



MATERIALS LIST—EDGEFINDER

Amount	Description
3"	1/2" dia. ground & polished drill rod
12"	.015" music wire
2 pcs	5/16" long x 16 ga. steel wire

pieces.

Using a drill pad or other support in the tailstock, place a piece of 400A carborundum paper on the pad and lap the mating surfaces square and flat by chucking the pieces and bringing them into contact with the paper at low speed and light pressure.

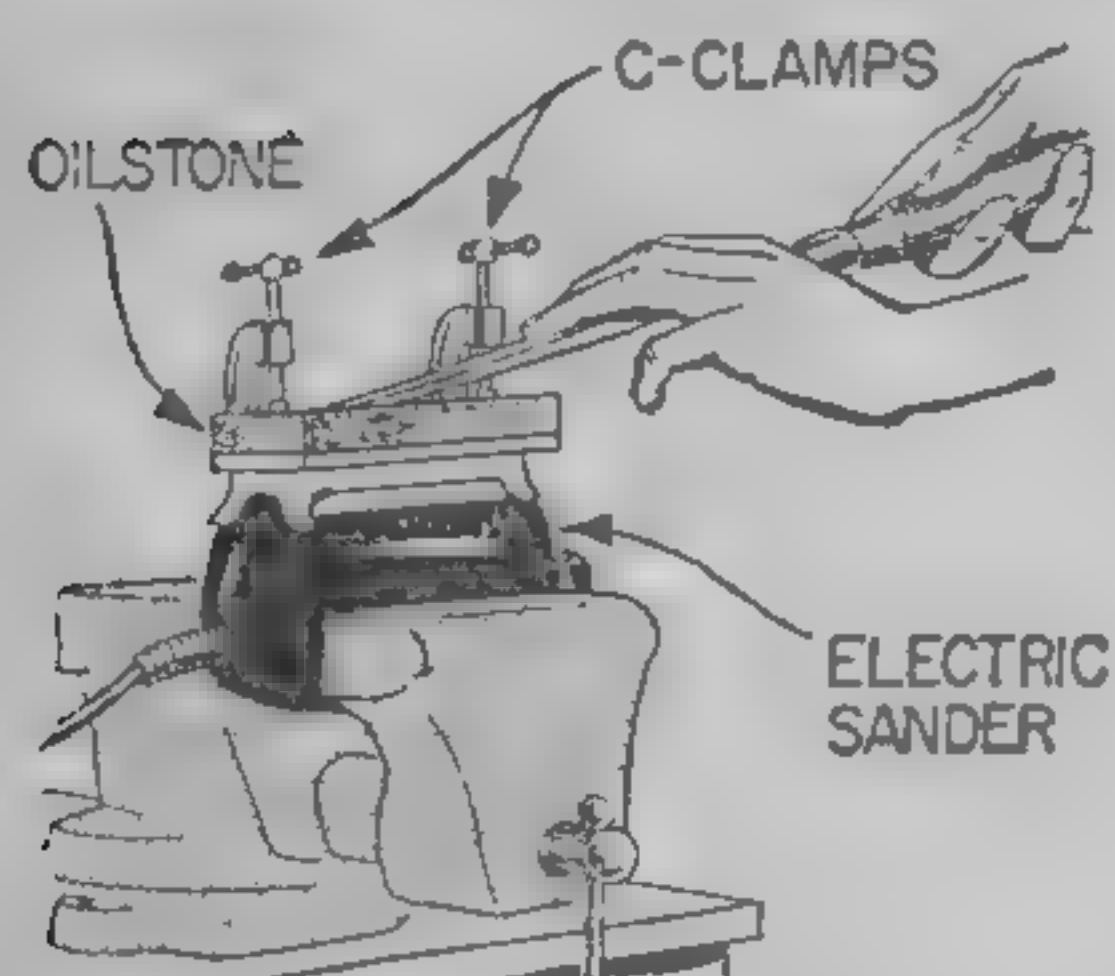
From a .015-in. music wire, wind a spring 3/16 in. dia. x 2 in. long on the lathe. Cut two 5/16-in. lengths of stiff wire for the spring retainers. Wipe lapped surfaces clean and assemble edgefinder, using a music wire hook to stretch spring until retainers are slipped in place.

To use the tool, chuck it in the milling machine. Move the bottom part of edgefinder 1/32 in. out of line with the shank as in the photo. With the work clamped in a mill vise, move the mill table until the edge of the work to be located is within 1/16 in. of the edgefinder. Turn the machine on using 1000 rpm or less and slowly bring the work into contact with the rotating tool until the bottom piece of the edgefinder snaps into line and runs true to the shank. Do not move the table past this point.

The centerline of the finder is now .250 in. from the edge of the work. To center the spindle over the edge, move the mill table .250 in. in the required direction.—NORMAN FRIED.

SHOP KINKS

Sander Sharpens Tools

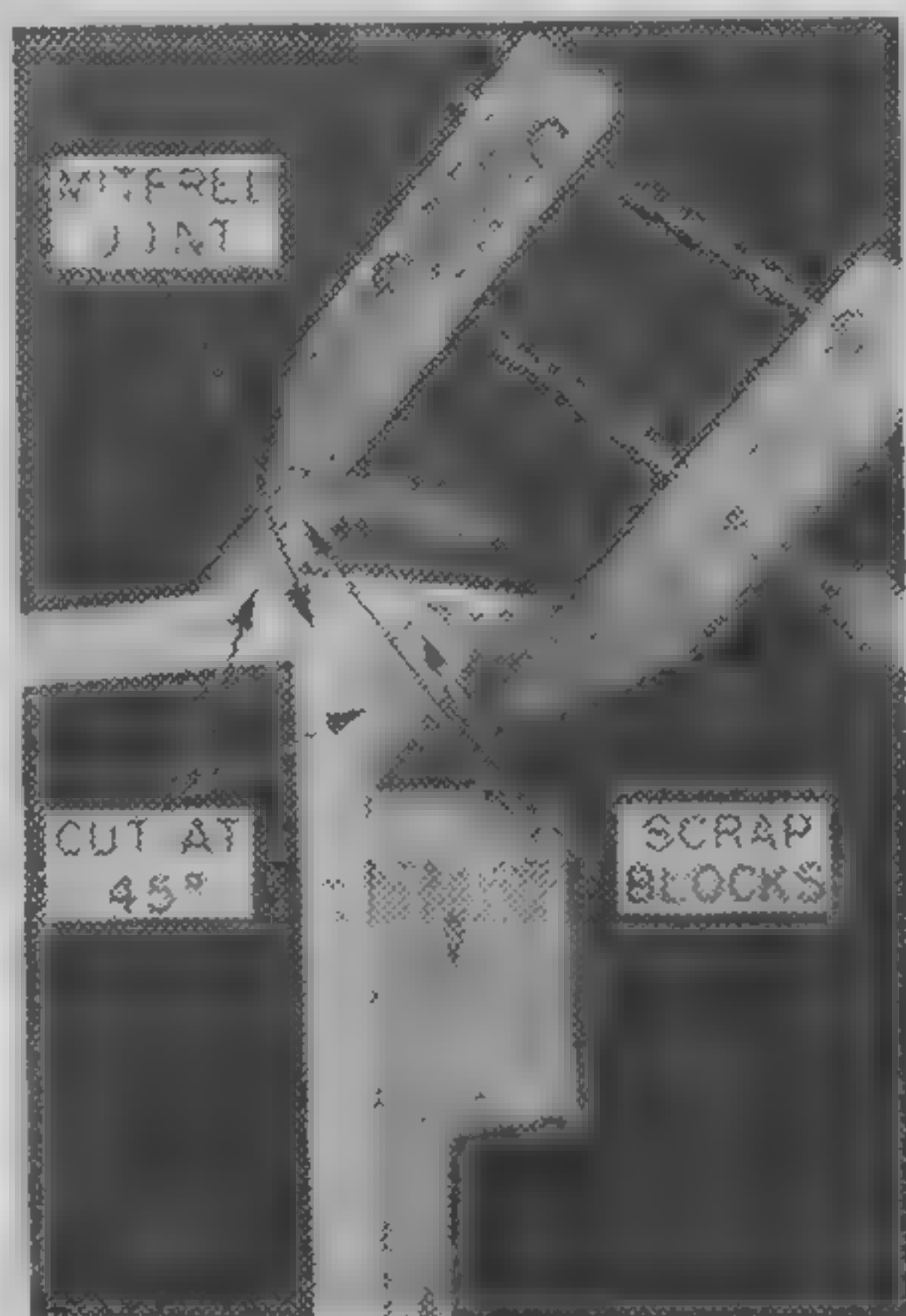


• If you have a smooth-running electric sander with forward and back motion, you can use it as a tool sharpener to put an edge on everything from a pocket knife to a small ax. Use a pair of small C-

clamps to attach an oil-stone to the face plate of the sander, then clamp sander in a soft-jawed vise. Speed of cut depends, of course, upon coarseness of stone used. The sander should not have too violent an action or you will have trouble in holding the tool against the stone properly. —G. M. BROOKE.

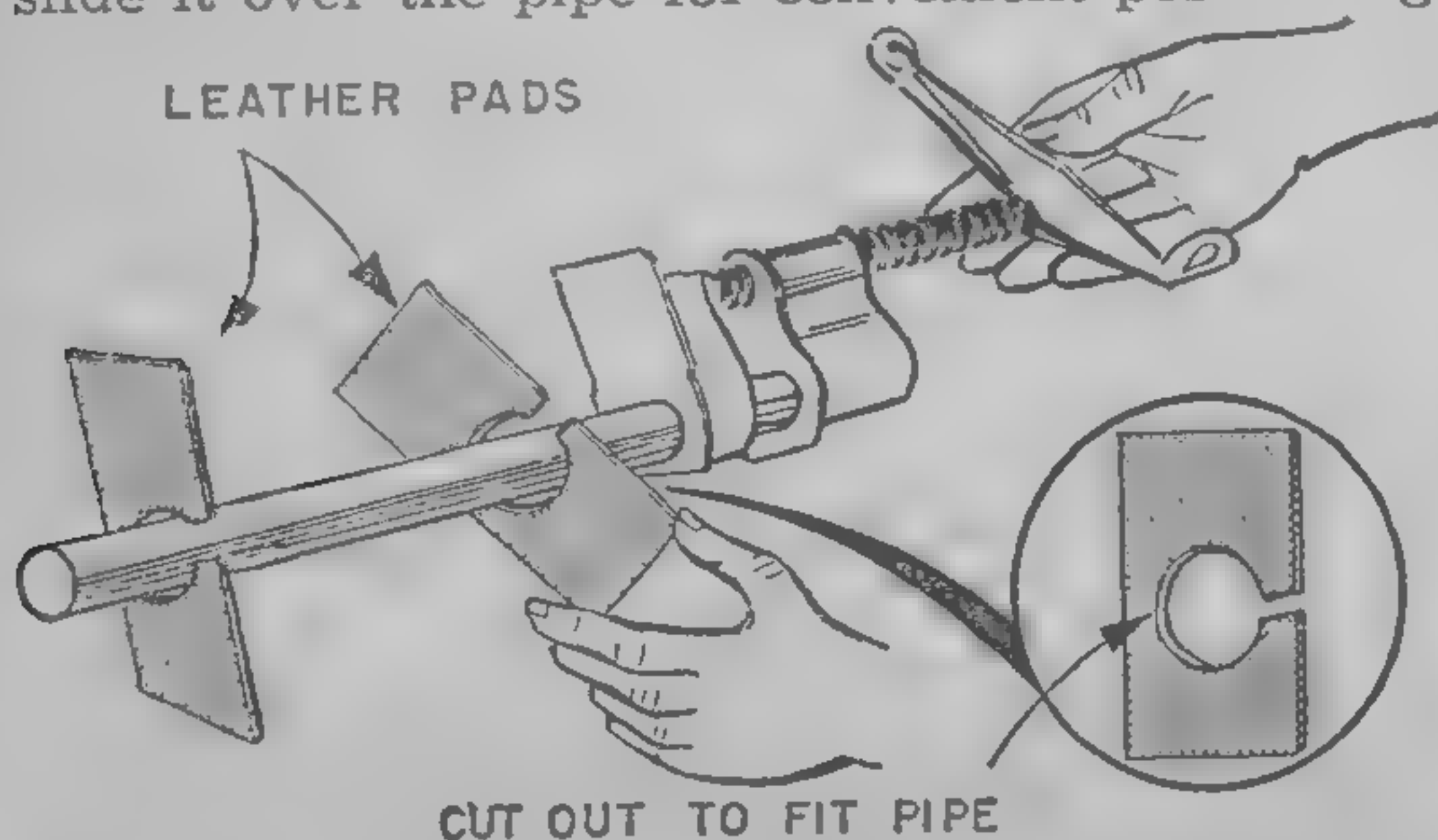
Assembling Mitered Joints

• A mitered joint is difficult to assemble without some means of holding the two pieces of stock. The fastest, easiest way to do this is to cut one edge of two scrap blocks at a 45° angle and tack-nail them to the project on either side of the joint. A clamp will then draw the parts tightly together and hold them firmly until the glue dries.—R. J. DeC.



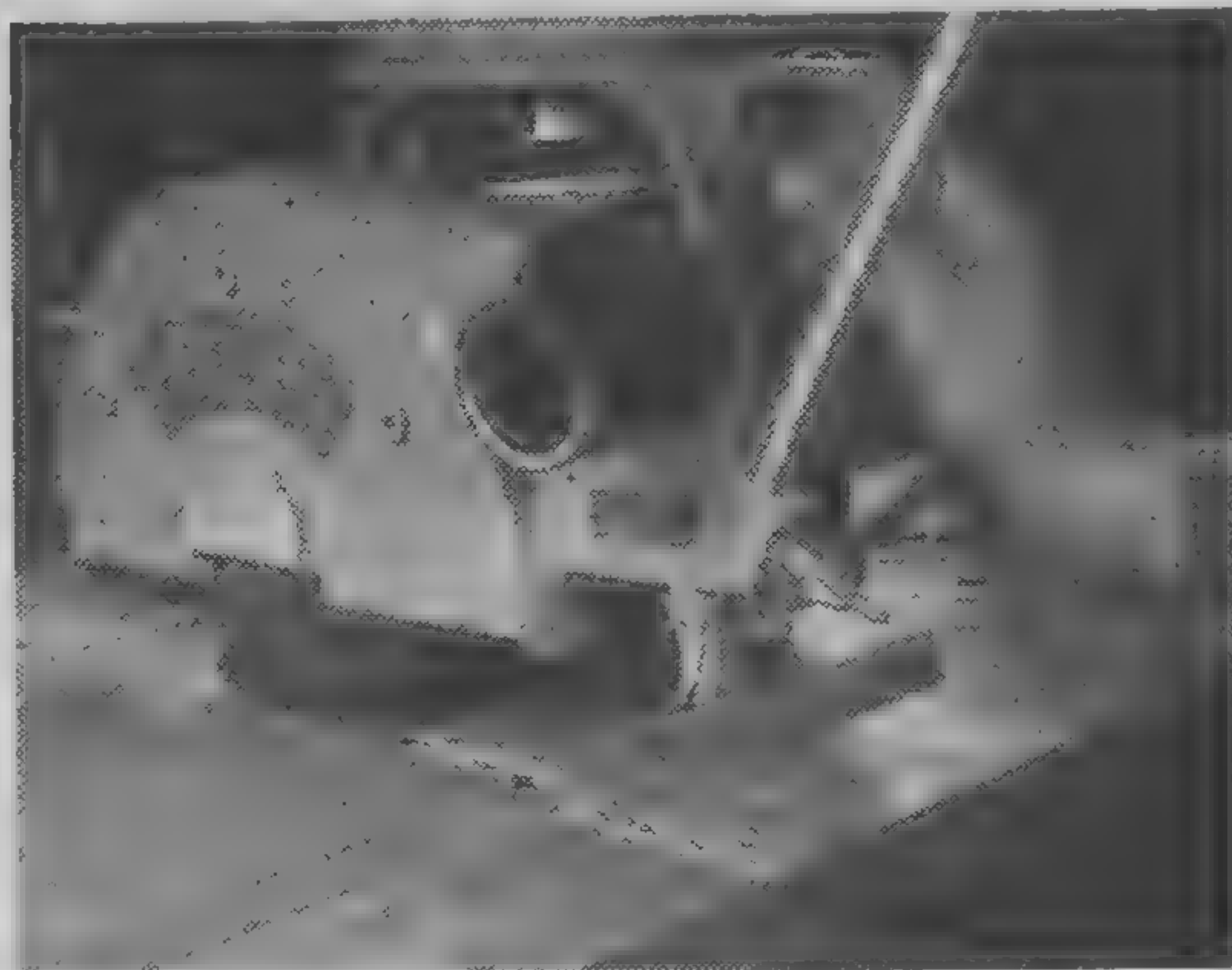
Leather Clamp Pad

• When clamping freshly-glued furniture with a bar or pipe clamp, use two leather pads to protect the wood from becoming marred. Cut the pads from an old boot or other scrap leather in the shape of the metal jaws of the clamp. A hole and slit in one end of each pad will enable you to slide it over the pipe for convenient positioning.



Stop Radial Saw Climbing

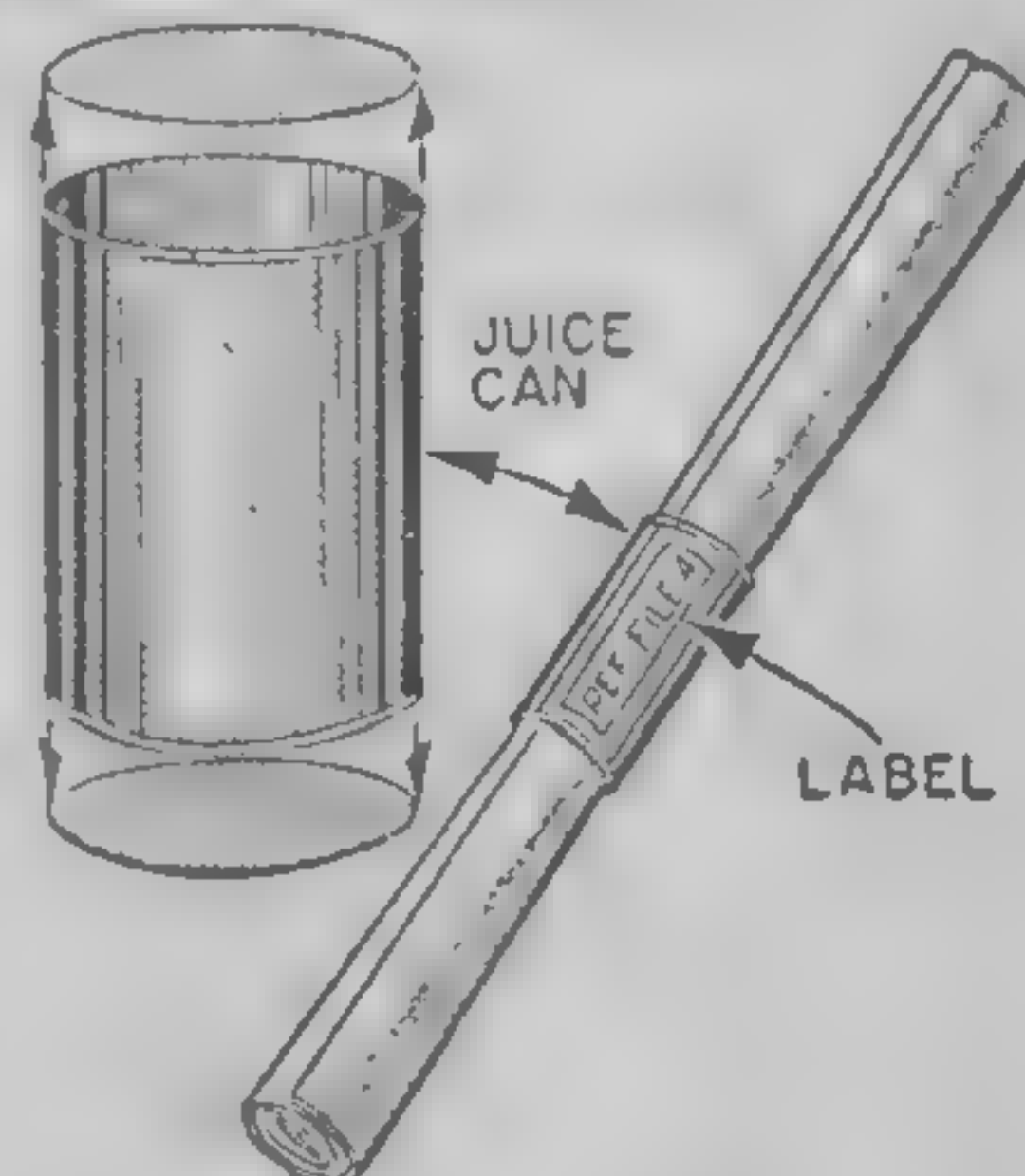
• The tendency of a radial saw to “climb” the stock when making a deep, wide cut is safely and easily overcome in the following manner. Pull



the motor head out to the front end of the arm, put the stock in position and *push* the blades through instead of *pulling* them. Since the blades are removing the stock ahead of them they can't possibly climb. As always, cuts are smoother when you cut slowly—let the teeth cut, don't force.—R. J. DeCristoforo.

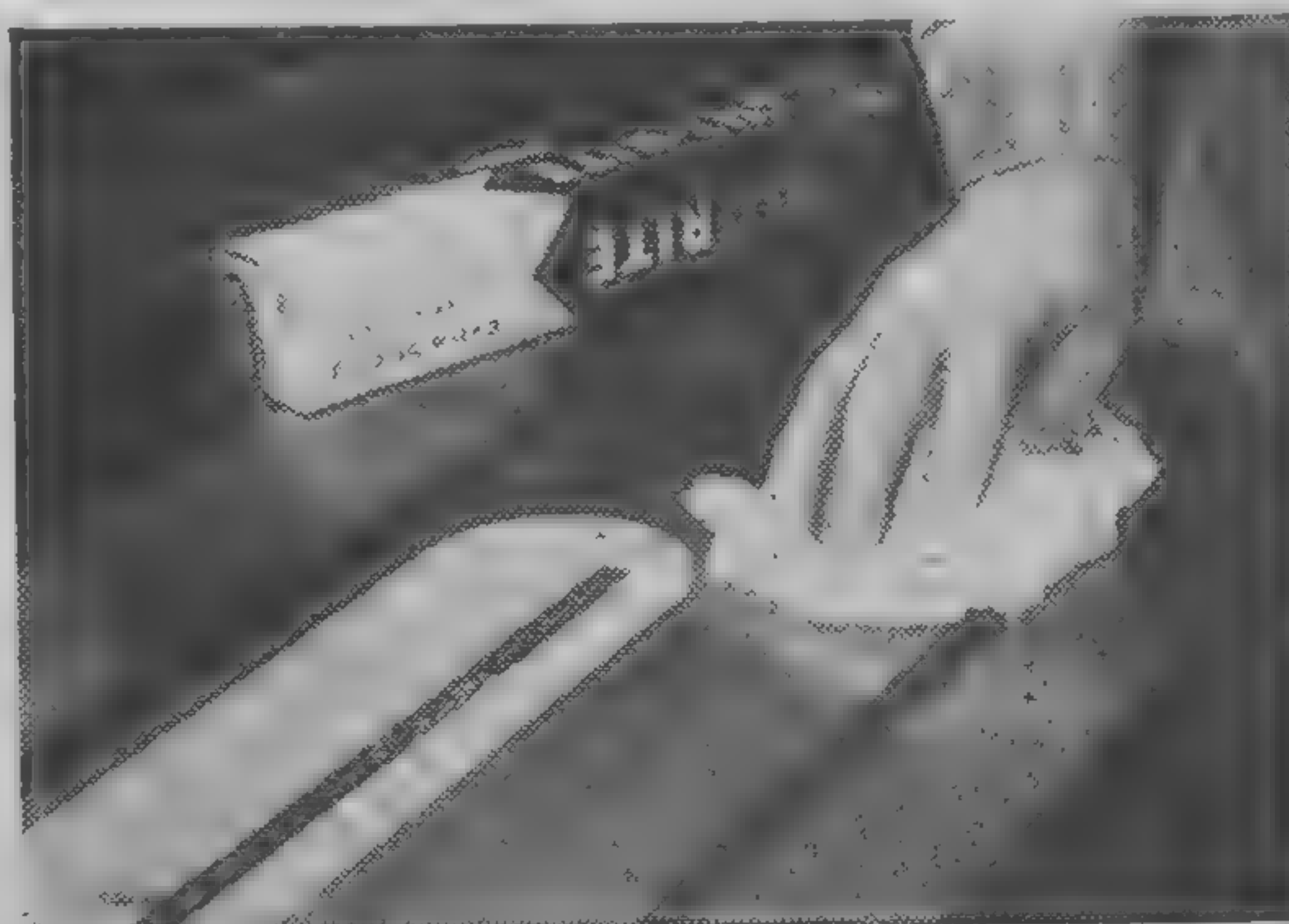
Cans Hold Rolled Blueprints

• Small fruit-juice cans with bottoms and tops removed make excellent “napkin rings” into which rolled blueprints may be inserted for storage or carrying. Attach identification label to cans for easy reference.—G. E. Hendrickson.



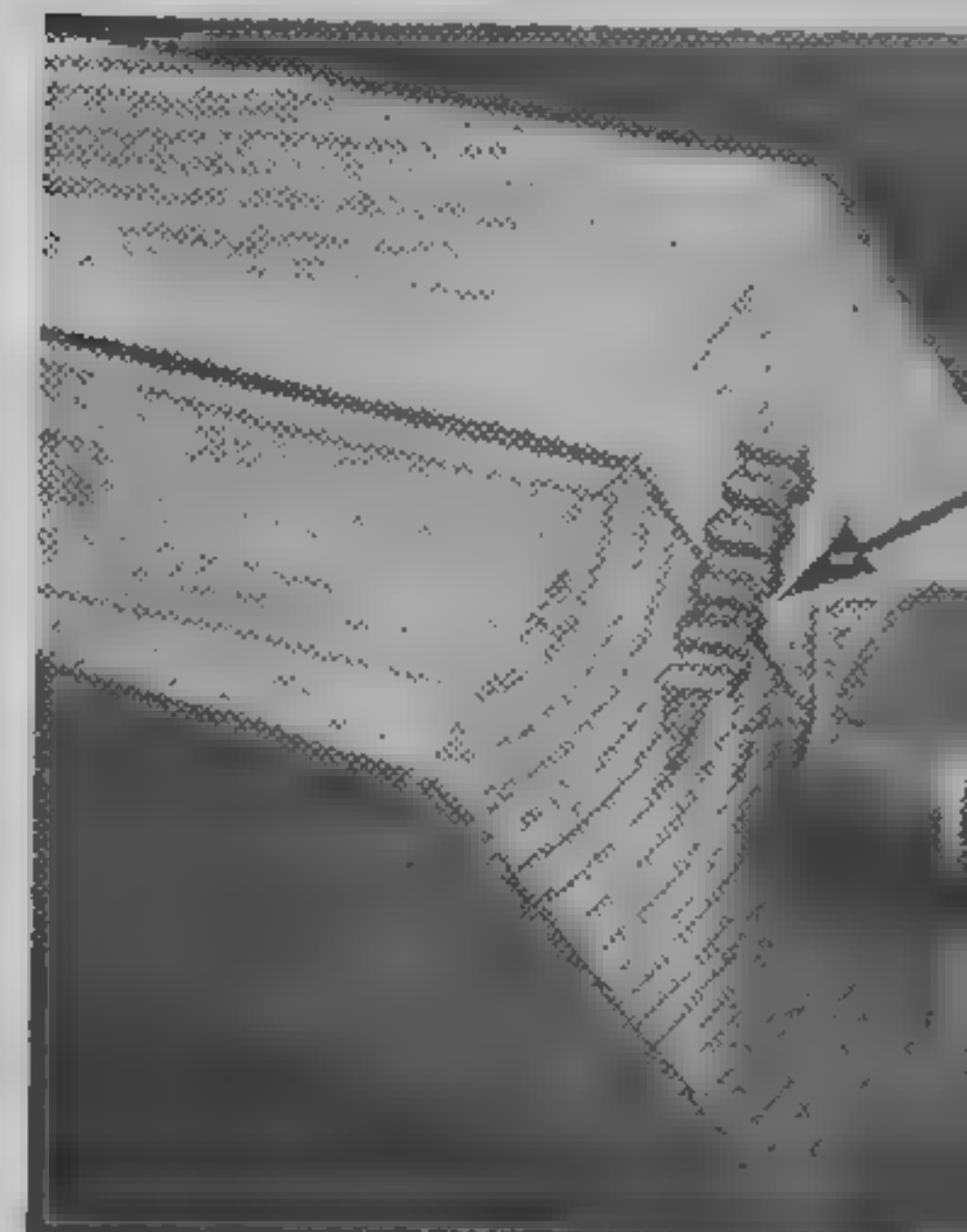
Wax Paper Cleans Tool Tables

• Rub ordinary wax paper briskly over your shop tool-tables. The tables will pick up paraffin from the paper, and thus the protection and lubrication it provides.—R. J. DeCristoforo.



Corrugated Nails

• When making half-round by the split-turning me



rugated nails to hold the two pieces of wood together. Use two corrugated nails in each

Washer Polishes

• When setting up any involving horizontal shaft leather washer onto each shaft between any two shaft will spin the leather in turn will “shuttle” between length of the shaft between rust-free and shining. The should be much larger than shaft, but need meet no shafting already installed. —ANDREW VENA.

Rest-less Dowels

• To turn dowel rods to rings, without a center rod to slip on the chisel, with a ride on top of the rod. A bit of sandpaper, over the entire rod without chisels make good cutters. the style molding you want stick into flat molding of quarter round. Try it. Hundreds of feet of molding

Taped Finger Hard-to-Release

• Starting a nut in an awkward corner or hole will be easy if you first wrap a bit of tape around the end of your finger, tacky side out. Press the tape against the nut to hold it until it is started on its bolt, then pull your finger away. —FRANK A. JAVOR.

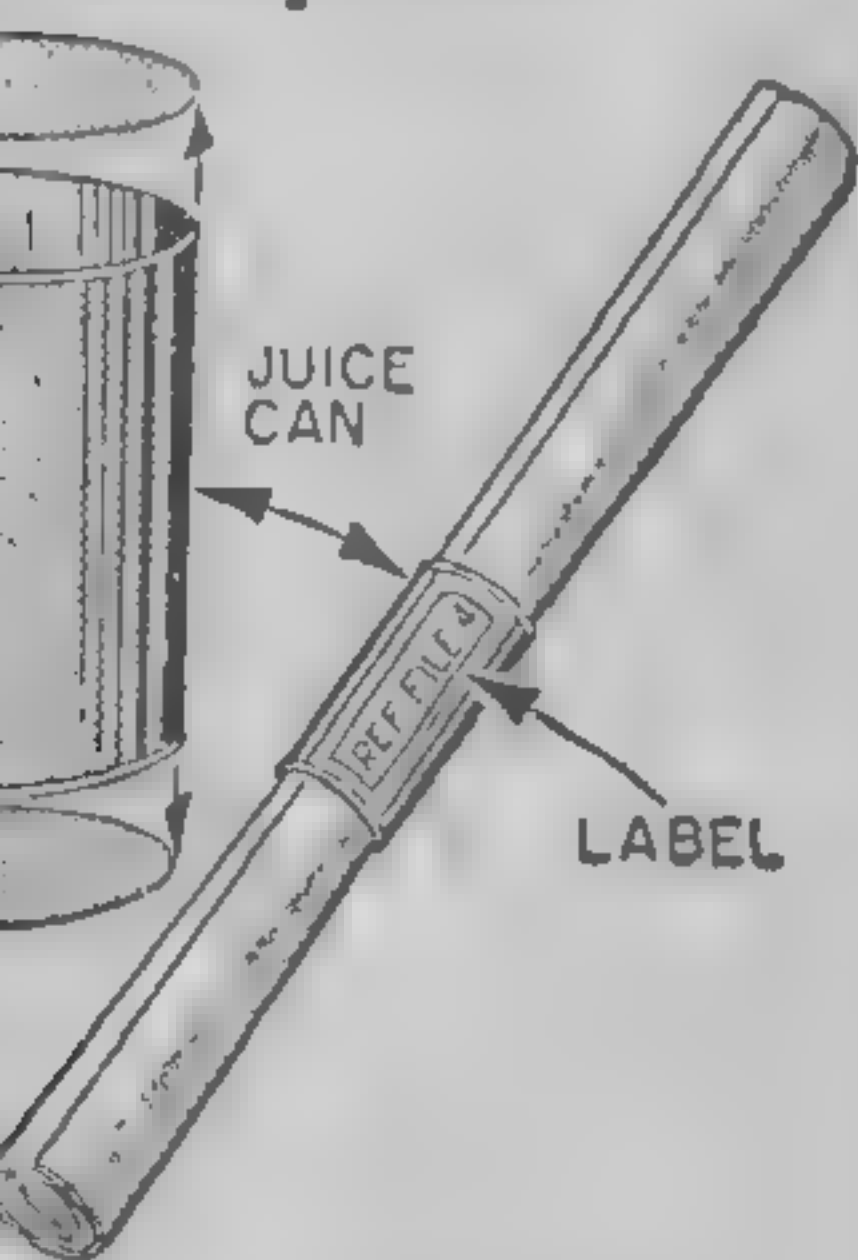
W Climbing

I saw to "climb" the wide cut is safely and following manner. Pull



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Blueprints



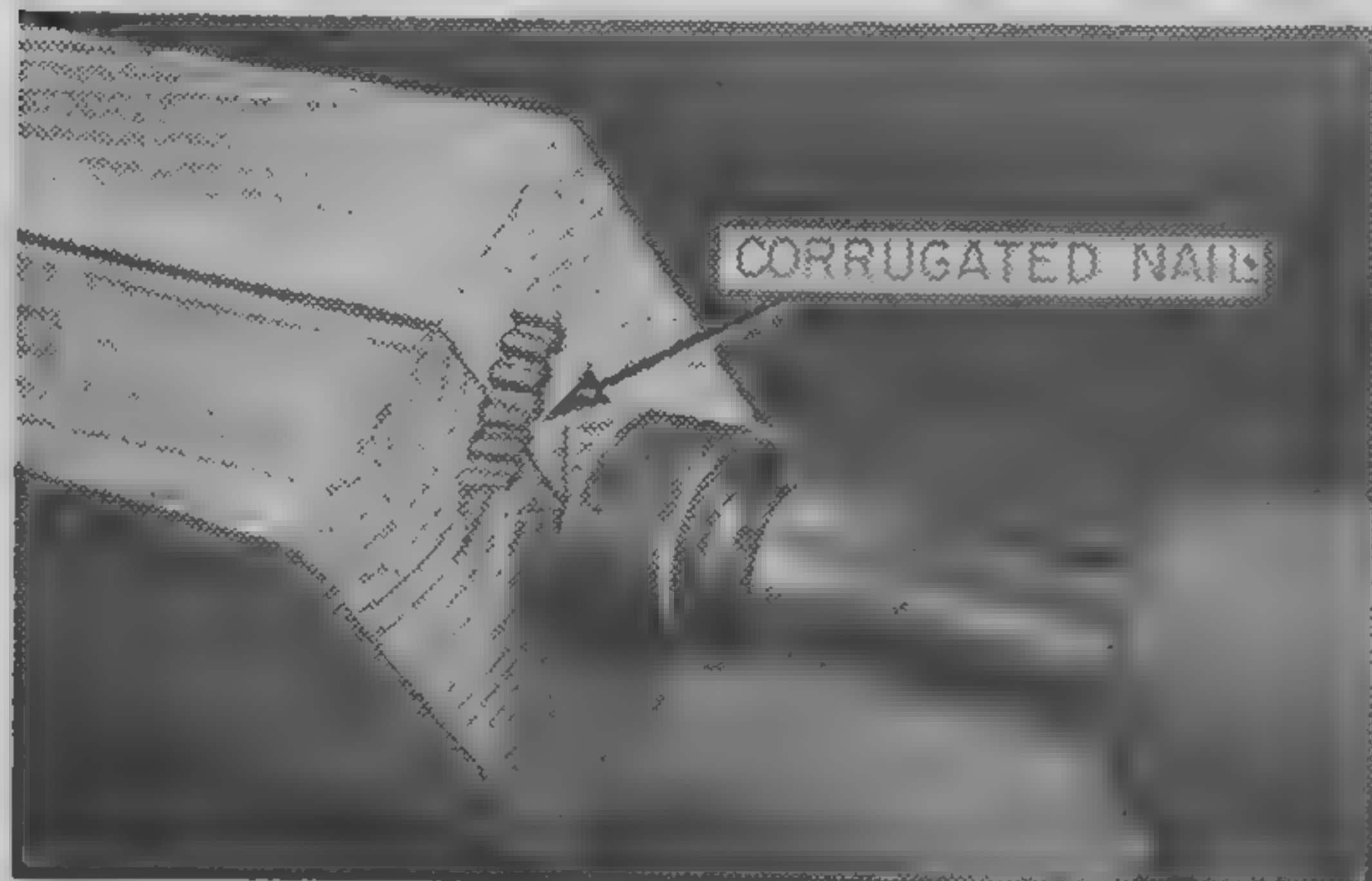
Tool Tables

briskly over your will pick up paraffin e protection and lu- DeCristoforo.



Corrugated Nails Hold Split Turning

- When making half-round moldings or pedestals by the split-turning method on the lathe, use cor-



rugated nails to hold the parts together. Clamp the two pieces of wood together, then drive two corrugated nails in each end.—R. DeC.

Washer Polishes Rotating Shaft

- When setting up any kind of machinery involving horizontal shafting, always slip a large leather washer onto each such section of rotating shaft between any two bearings. The spinning shaft will spin the leather washer, and the washer in turn will "shuttle" back and forth along the length of the shaft between bearings, keeping it rust-free and shining. The hole in the washer should be much larger than the diameter of the shaft, but need meet no specific dimensions. For shafting already installed, split the washer to install.—ANDREW VENA.

Rest-less Dowel Turning

- To turn dowel rods to be cut into fine moldings, without a center rest, make a metal guard to slip on the chisel, with two prongs bent up to ride on top of the rod. Place one hand, with a bit of sandpaper, over the work. You can turn the entire rod without chattering. Molding plane bits make good cutters. Shape them to make the style molding you want. Rip the completed stick into flat molding quarter round or three-quarter round. Try it. I have made many hundreds of feet of molding this way.—U. S. MOORE.

Taped Finger Starts Nut in Hard-to-Reach Spot

- Starting a nut in an awkward corner or hole will be easy if you first wrap a bit of tape around the end of your finger, tacky side out. Press the tape against the nut to hold it until it is started on its bolt, then pull your finger away.—FRANK A. JAVOR.



Rubber Tubing Makes File Handle

- Small diameter rubber tubing, slipped over the short tang of a file, will protect your palm from the sharp point. The tubing costs less than a wooden handle, goes on in seconds, and will save room in a crowded toolbox.—FRANK A. JAVOR.



Valves Make Radii Templates

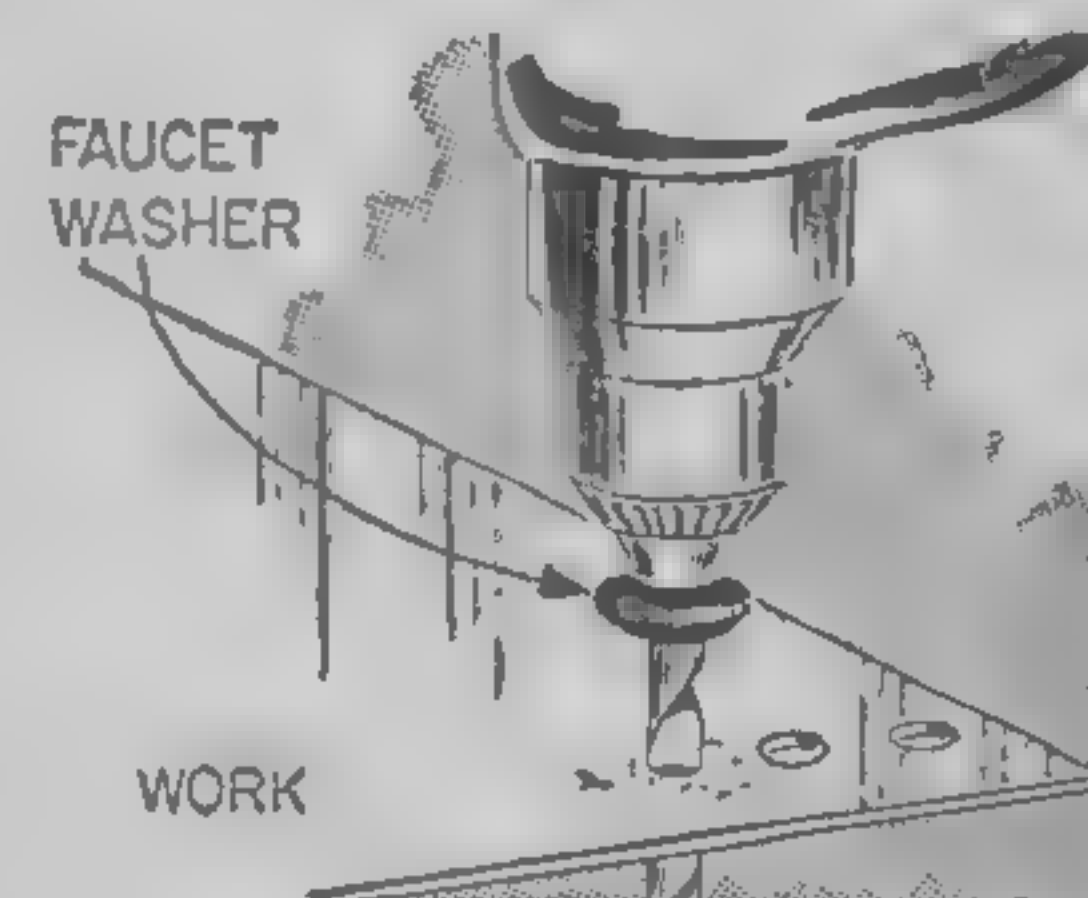
- A set of various-sized valves provides an easy method of drawing radii on corners of shop projects. Ask your local garageman to let you



search through his junk pile for an assortment of various sizes. Hold the valves firmly in place by their stems while tracing around the outside edges with a pencil or sharp scribe.—ARTHUR R. TANNER, JR.

Drill Chuck Cushion

- When drilling a number of holes in polished metal, prevent the drill chuck from slamming against it when the drill breaks through and marring the metal, by slipping a rubber faucet washer over the bit. Slide it up against the chuck. If necessary, enlarge the washer hole for larger bits.—VICTOR H. LAMOY.



Lathe Chuck Index

WANT big easy-to-see knobs and collars for your tools and measuring instruments? Or finely divided dials for radio and electronic equipment? You can make them by using your lathe as a "rotary engraving machine."

Accuracy of the method depends mainly upon the sharpness of your pencil, or scribe and, of course, the setups on the lathe must be solidly positioned.

You will need a 1/2-in. strip of tough flexible non-stretch paper, acetate or, for permanence, use thin sheet metal. Wrap the strip around the lathe chuck and cut it exactly equal to the circumference. Then tape it firmly to a drawing board, to mark it (Fig. 2).

If you want to divide a collar into 25 parts, as on a micrometer cross feed dial for a lathe, use

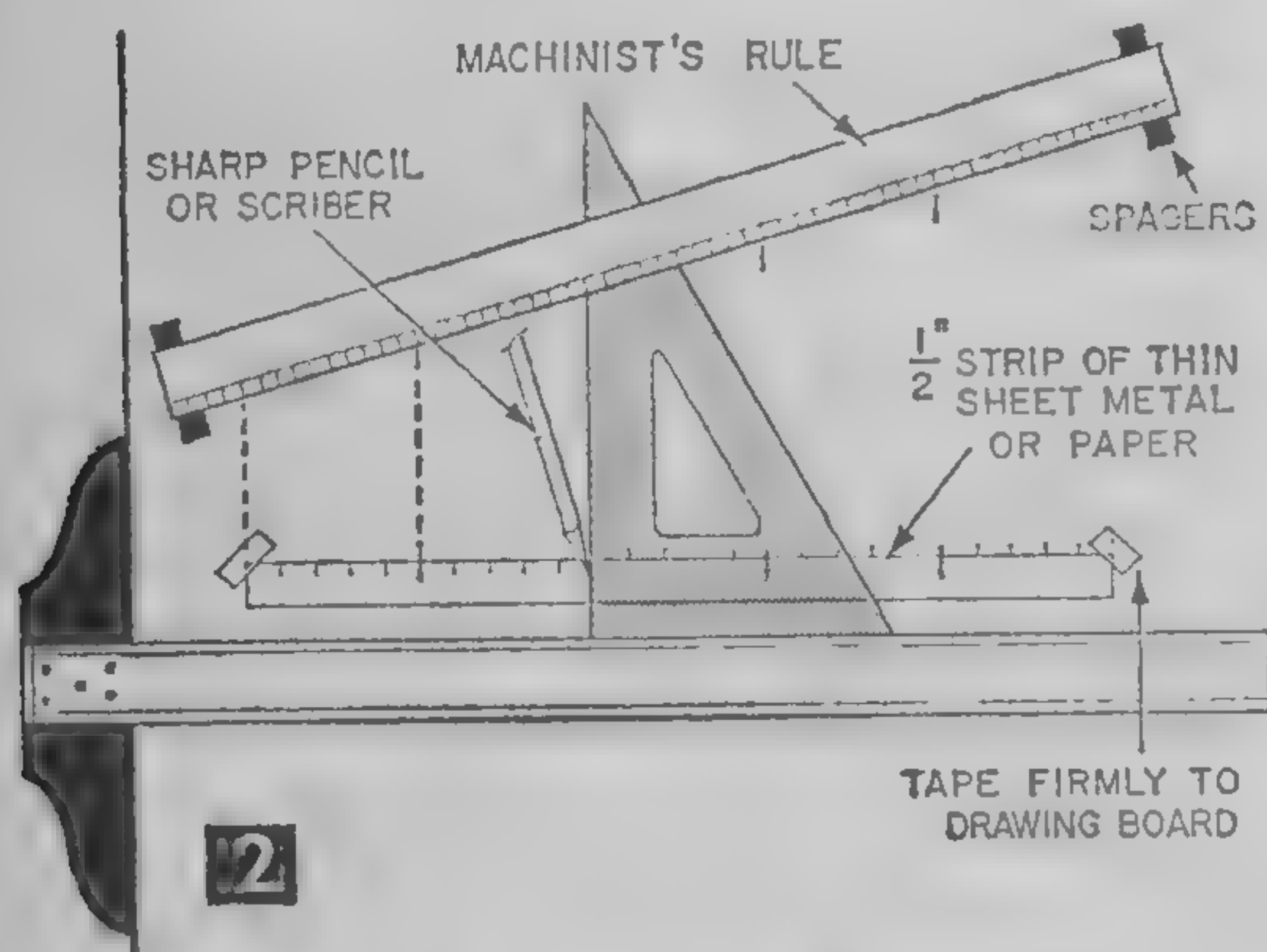


Fine line graduations are engraved on collars and dials with this lathe chuck accessory.

a machinist's rule divided into hundredths, or use a series of fractions of an inch that will give you the desired number of divisions. Mark the strip, either with fine pencil, or prick it with a sharp needle.

Now, fasten the strip around the lathe chuck with tape. The pointer can be improvised by clamping down a small surface gage, or you can fasten a pointer to the headstock casting. The work piece can be held on a mandrel, or in the chuck itself, and the marks are engraved with a sharp scriber held in the tool post, by moving the carriage back and forth.

For different lengths of lines, mark the lathe bed with pencil. Always sight the pointer carefully for maximum accuracy. The method shown can also be used for index drilling, inspection and other machining operations.—H. J. GERBER.



Lathe Collet Adapter

THREADED to fit the spindle of your lathe, this adapter needs no draw bar, and thus extends the collet capacity of your lathe up to sizes that otherwise would require a larger machine.

With careful workmanship the adapter should equal the accuracy of your lathe itself. The principle is used on many big machine tools; instead of a draw bar pulling in the collet, the cap (Part B) pushes on the convex nose of the collet, enabling you to chuck larger sizes of bar stock, for precise machining.

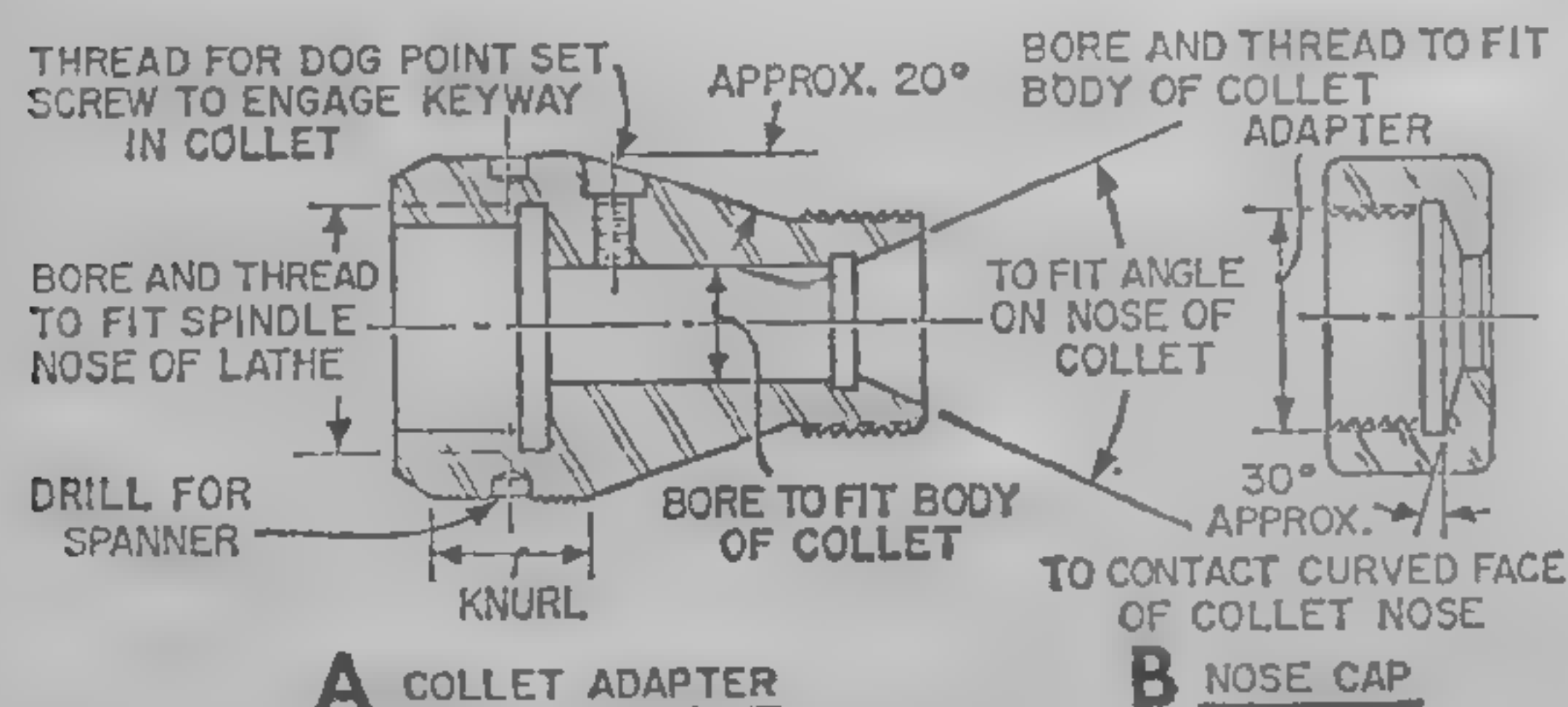
Plan your sizes according to the size of your lathe, and the collets you use, and then bore and



Chucking with collets means real accuracy. This adapter does the work of costly draw bar outfits, and handles bigger sizes.

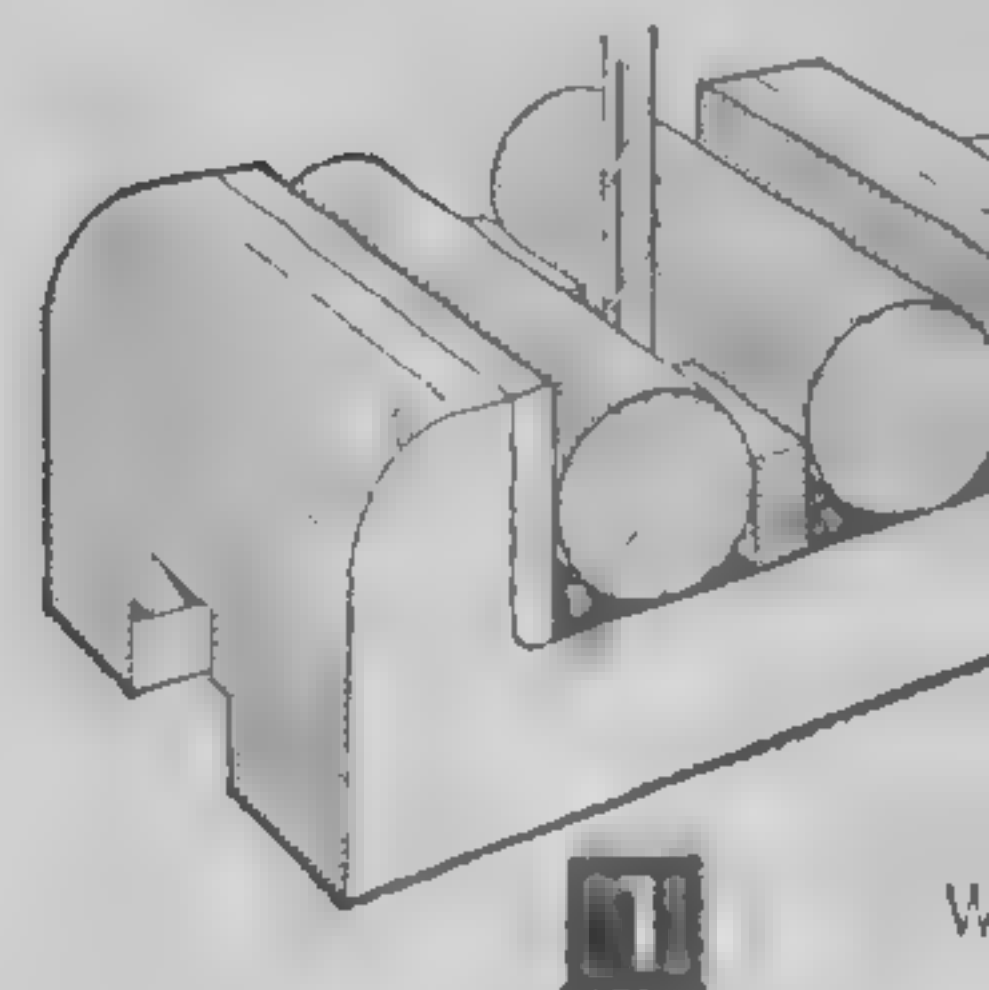
thread part A to fit your lathe spindle. Then mount it on your lathe, and machine the O.D. and I.D. Next, (optional) case harden it for longer wear. Finish the bore and internal taper with a tool post grinder. The dog point set screw keeps the collet from rotating.

Machine the nose cap (B) and thread to match part A. Face the inside to match the curvature of your collets, or use an angle about equal to it. The outside slots are for hand grip, and spanner wrench use, and the nose cap can also be hardened.—H. J. GERBER.



Improved V-Bit for R

To cross-drill round center on a drill press, of the same thickness drill, between two sh



stock, thus improvising Center the drill by low stock and clamp the vi Place the work on the the hole.—C. W. WOOD

Avoiding Loos

Moisture picked up make dowels swell end them down to match t you plan to use them in tent returns to norma



Label the tubes (you can come in) so you can tell a length of the

shrink, causing a loose

To avoid this problem cardboard mailing tube stores. Seal one end of t and close the other end wood stopper. You can tubes on hand to accom lengths.—F. HEGEMEYER.



Engraved on collars and chuck accessory.

into hundredths, or an inch that will give divisions. Mark the 1, or prick it with a

und the lathe chuck n be improvised by ace gage, or you can dstock casting. The a mandrel, or in the are engraved with a post, by moving the

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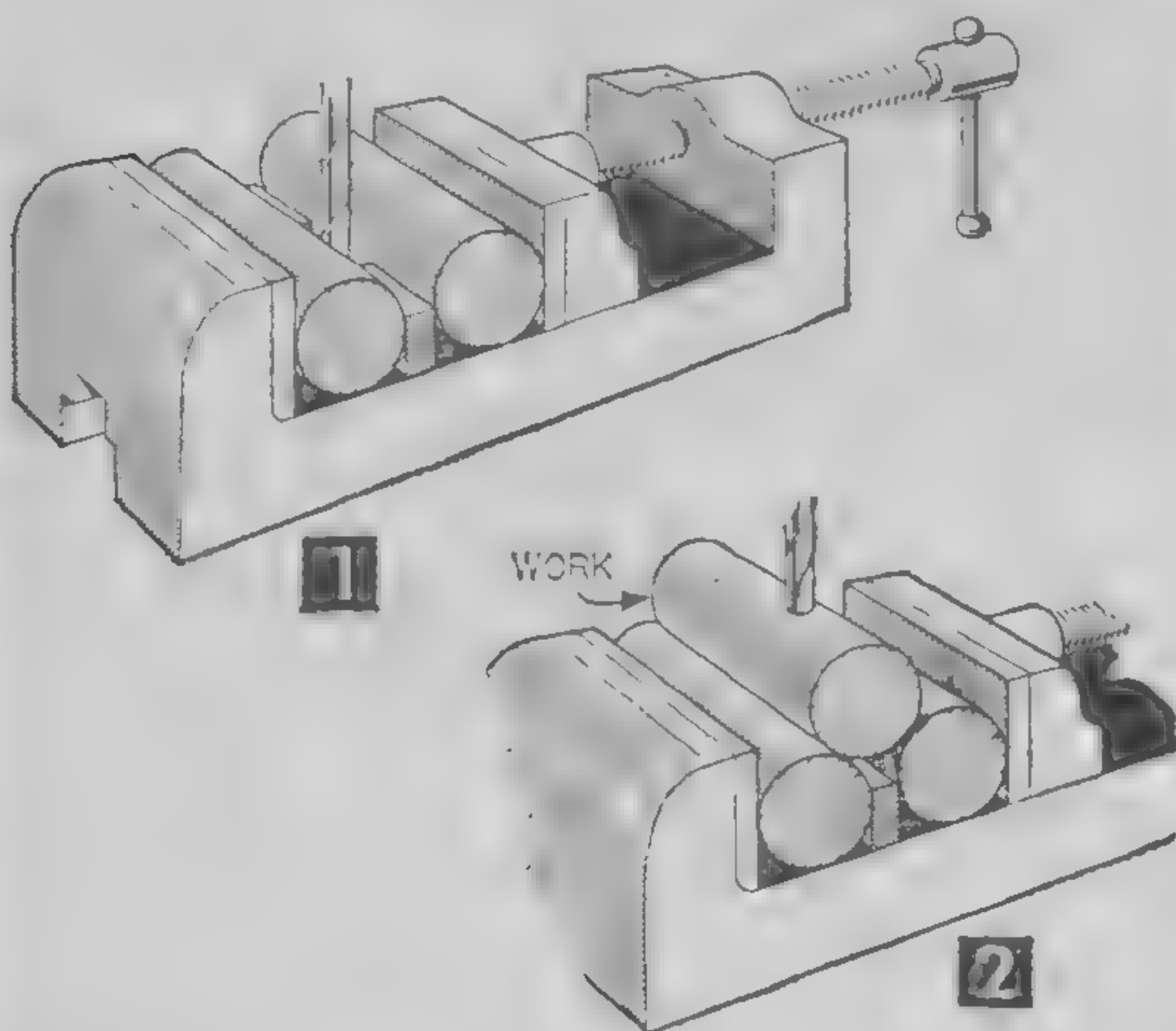
real accuracy. This draw bar outfits, and sizes.

athe spindle. Then machine the O.D. case harden it for and internal taper dog point set screw

and thread to match match the curvature le about equal to it. d grip, and spanner o can also be hard-

Improved V-Block Centers Drill Bit for Round Stock

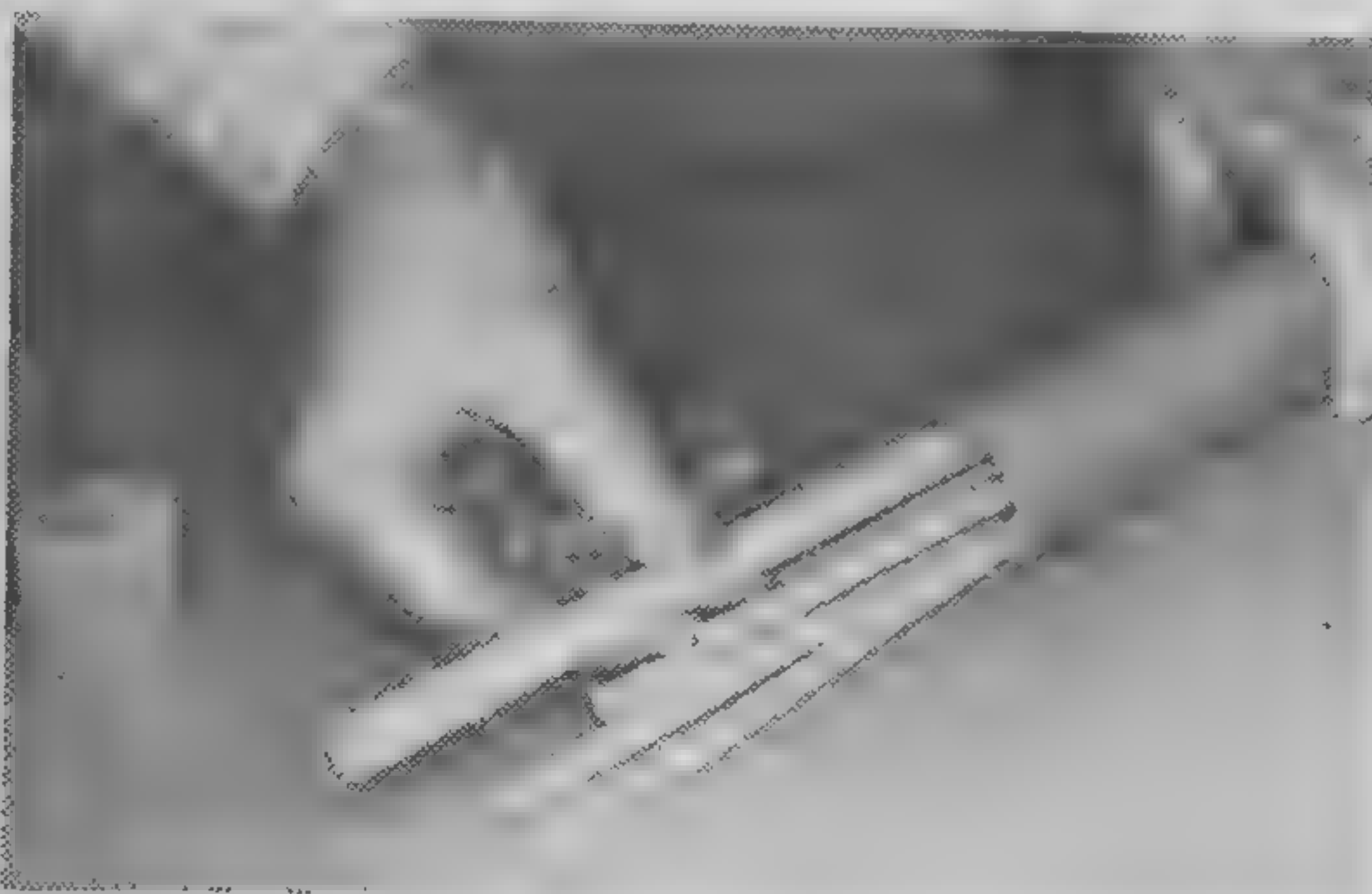
To cross-drill round work through its exact center on a drill press, clamp two flat steel blocks, of the same thickness as the diameter of the drill, between two short lengths of round bar



stock, thus improvising a V-block as in Fig. 1. Center the drill by lowering it between the bar stock and clamp the vise to the drill press table. Place the work on the V-block, Fig. 2, and drill the hole.—C. W. WOODSON.

Avoiding Loose Dowel Joints

Moisture picked up in a damp location can make dowels swell enough so you have to dress them down to match the diameter of the holes you plan to use them in. When the moisture content returns to normal, the dowels will then



Label the tubes (you can use those that calendars come in) so you can tell at a glance the diameter and length of the dowels therein.

shrink, causing a loose joint.

To avoid this problem, store your dowels in a cardboard mailing tube, available at stationery stores. Seal one end of the tube with a wood plug and close the other end with a cork or tapered wood stopper. You can keep several of these tubes on hand to accommodate dowels of varying lengths.—F. HEGEMEYER.

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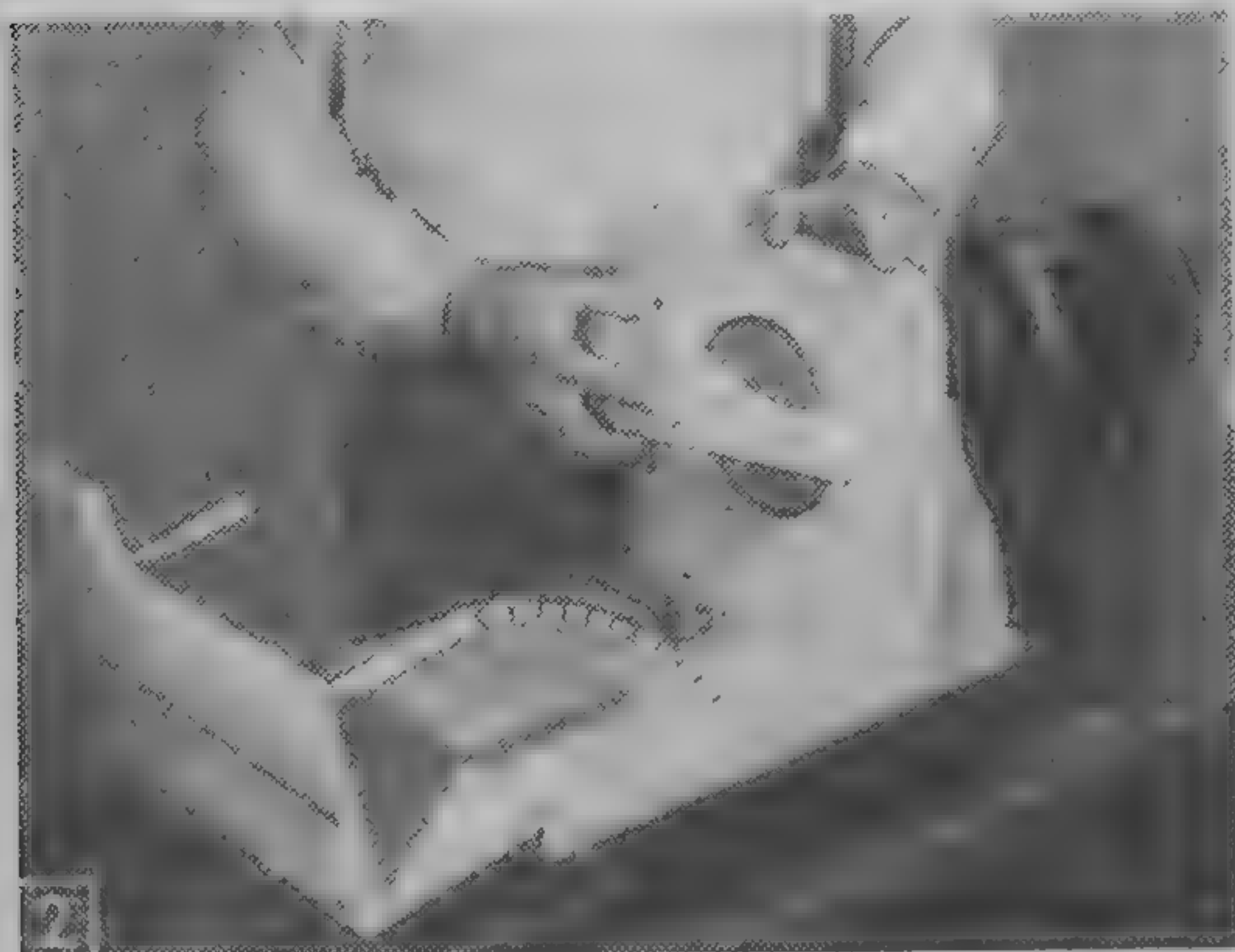
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FREE
BOOK



Press down on your "cushion" table, and slide the work piece under the sander. Then release the pressure, allowing the springs to press the stock upward, for accurate, even sanding. Adjust your drill press quill to regulate the pressure.



The vertical table eliminates uneven sanding marks and gouging of the work piece. Horizontal table is shown hinged out of the way to increase working space.

PRESSING gently downward will free the work piece, when you are sanding with the resilient auxiliary table on your drill press (Fig. 1). Or providing an all-around support for lathe sanding jobs (Fig. 2), gives you safer control of the work.

Both auxiliary tables help prevent stalling of the machine or burning the wood in one spot.

You will also find that you get more service from each sanding disc, because with either table, every part of the abrasive surface is made usable.

The Drill Press Table dimensions depend on the size of work you plan to handle. Figure 3 details an 18-in. table which would be ample for sanding table legs, cabinet parts and fittings not longer than about 2 feet. If, however, you plan to sand a lot of longer work, then increase the length proportionately. Make any fence you use about 2 in. longer than the table to guide the work, and for ease in clamping. Note cutout portion of table (Fig. 1) for use in clamping down a fence. For greater accuracy, you can use a straight metal bar or angle for the fence.

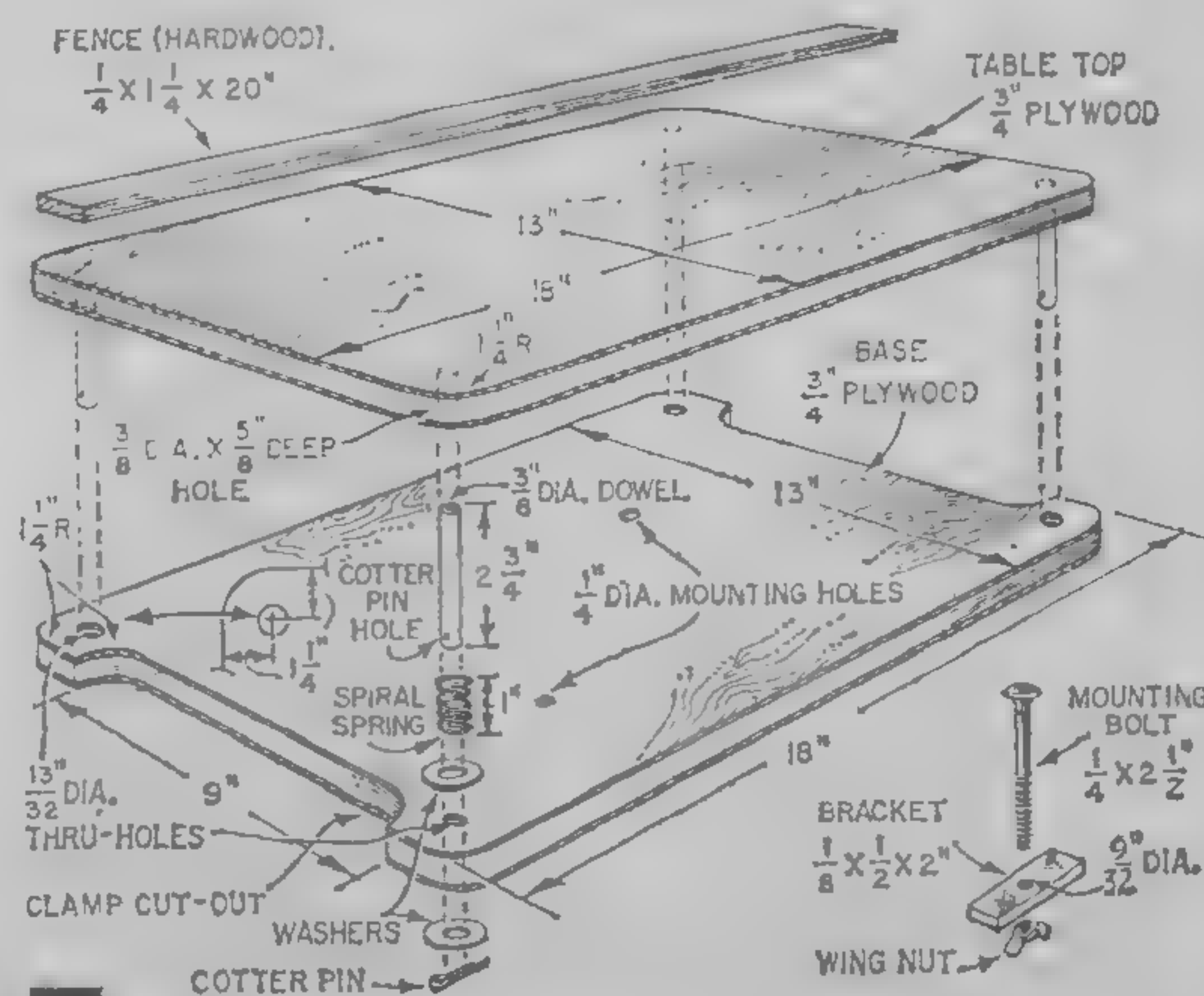
The dowel holes in the base and table must

"Old Pro"-Designed Sanding Tables for Drill Press or Lathe

Adding "cushioning" action
and all-around support pre-
vents binding and scorching

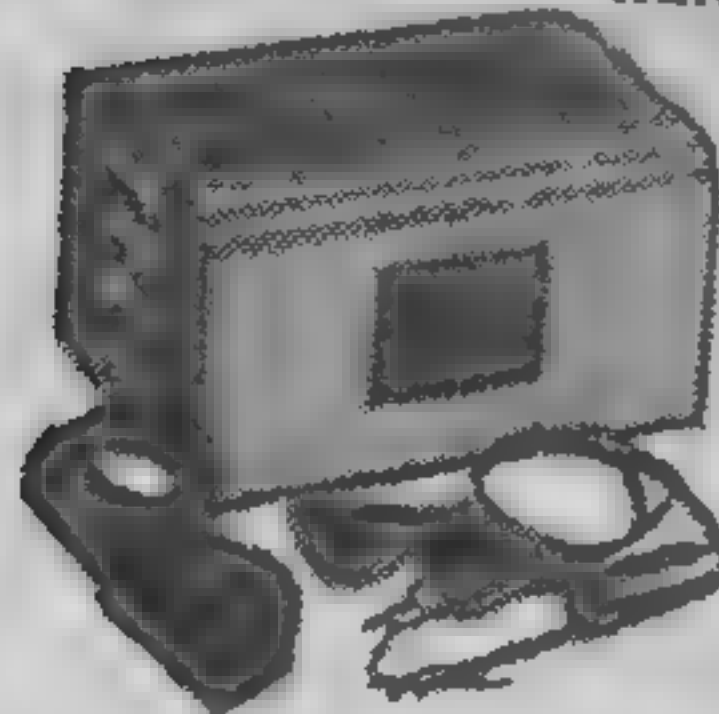
be lined up accurately. Clamp the table and base parts together and drill the holes simultaneously, with the base up on top. Use the depth stop on the drill press, since the holes in the table part have a depth of only $\frac{5}{8}$ in. Then enlarge the through holes in the base with a drill or round file to $1\frac{3}{32}$ in. Place the base on your drill press and drill the mounting holes to match diagonally opposite slots in the table casting. Note that the mounting brackets are made slightly narrower than the drill press table slots, so the device can be quickly removed.

Fasten the dowels with glue and coat their tops with paraffin or paste wax to prevent binding. Coat the table surface lightly with linseed oil, for easy action. Paint the rest of the assembly to match your drill press. Since the washers must slide freely on the dowels, you will need to ream or drill the standard $\frac{3}{8}$ washers up to $1\frac{3}{32}$ in. The rotary sander shown in the illustrations is a Kwik-Sand unit, available for \$9.95 from Creative Products, 2324 Hartzell Street, Evanston, Illinois. It offers an improved sandpaper gripping feature. However, you can use any one of the many types of sanders available, provided the disc is true and solidly chucked and the paper is securely fastened.



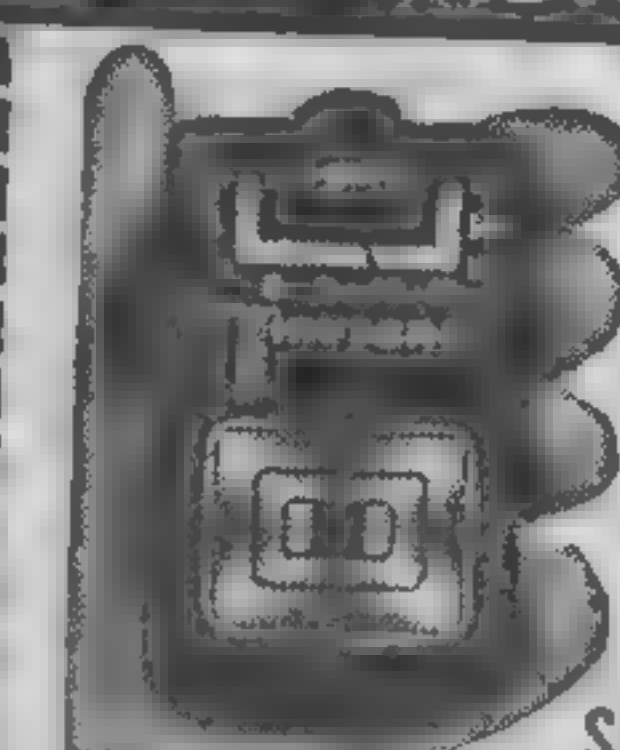
3. DRILL PRESS SANDING TABLE (DESIGNED FOR ROTARY SANDERS)

4 SIMPLE
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ANYONE CAN WELD
HEAT MOST



Sent complete with twin carbon arc torch, welder's shield, carbon, welding and brazing rods. Ready to use.

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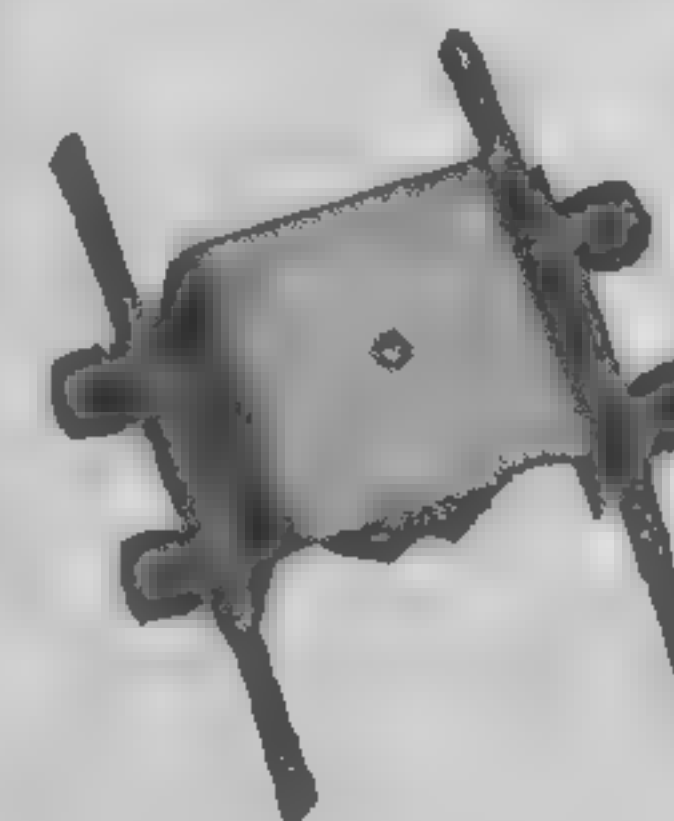
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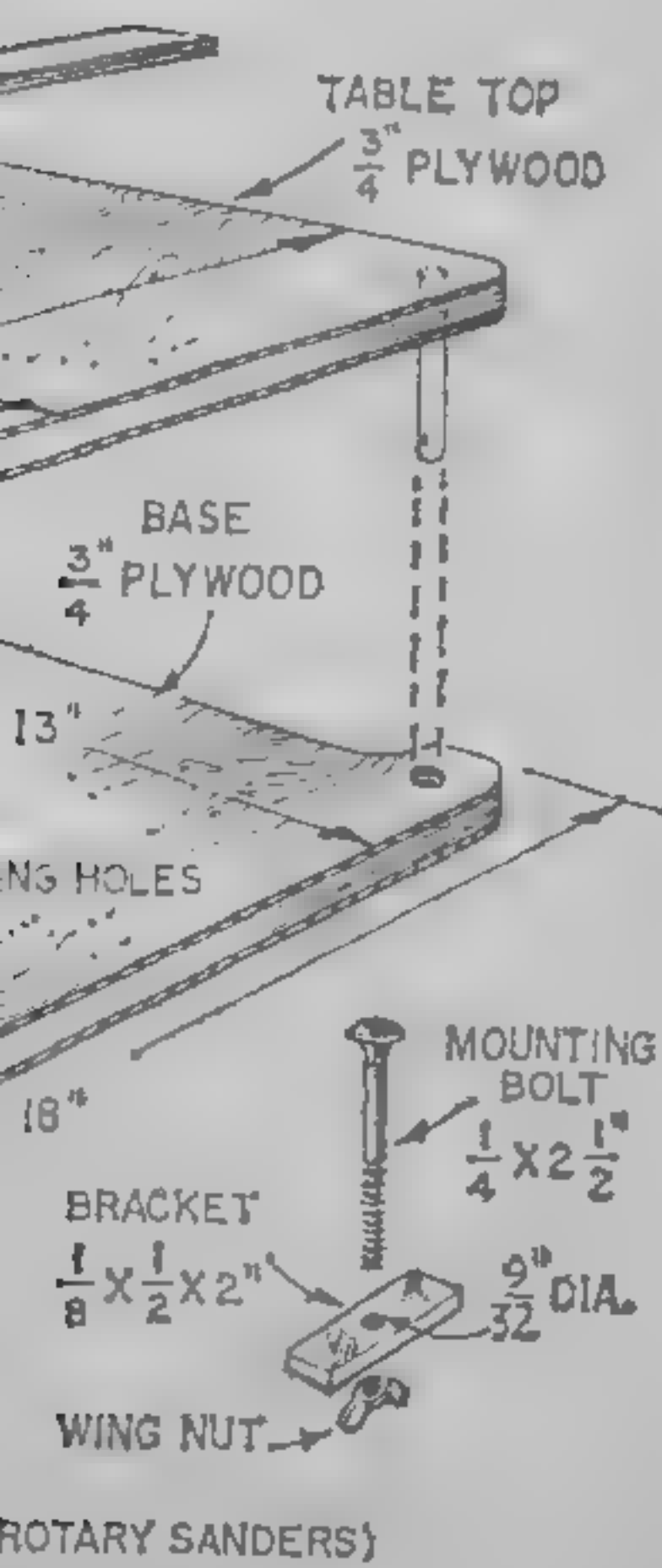
632 NEW HAVEN AVE

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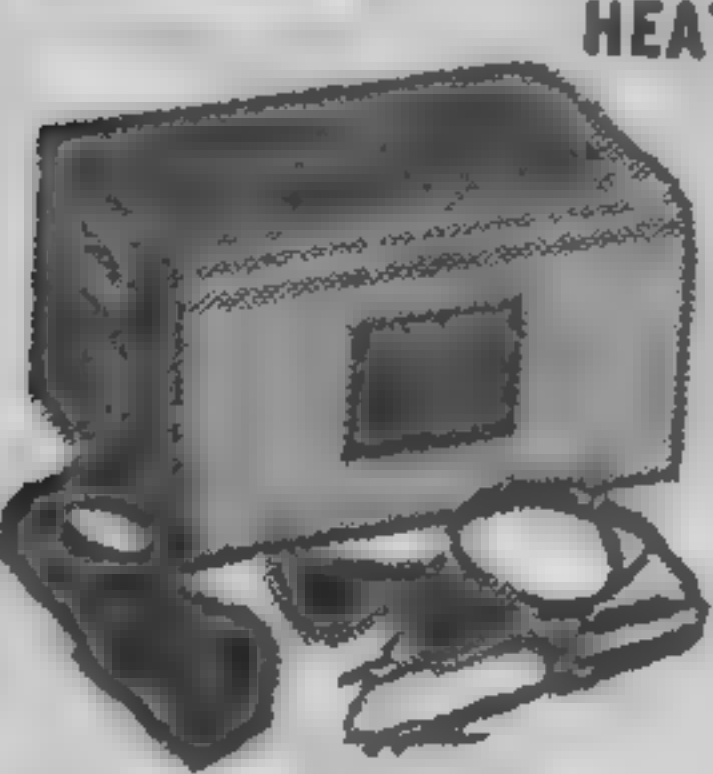
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CE AND MECHANICS

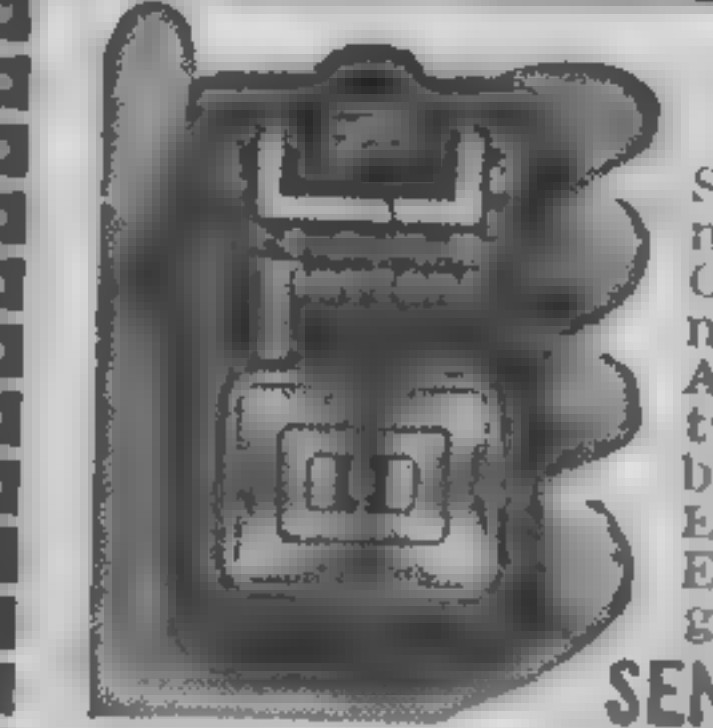
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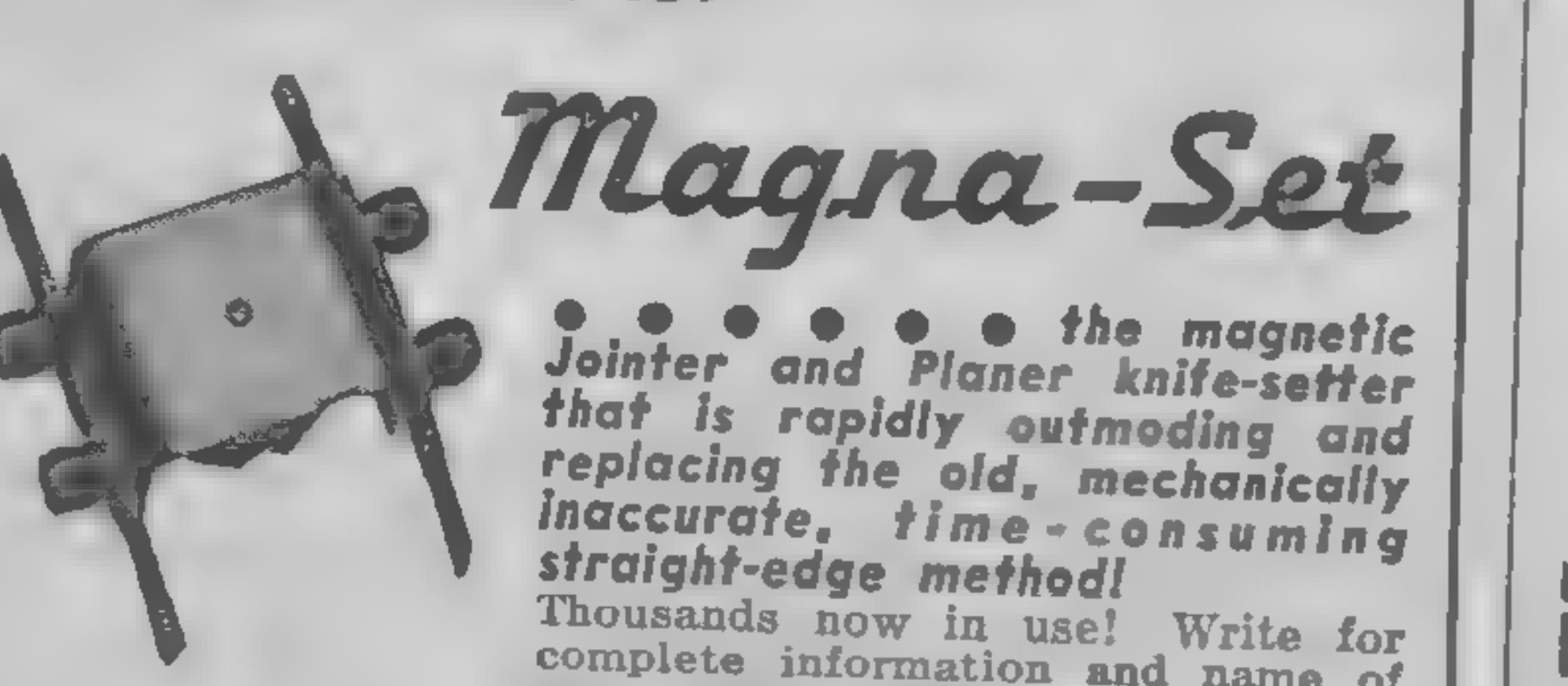
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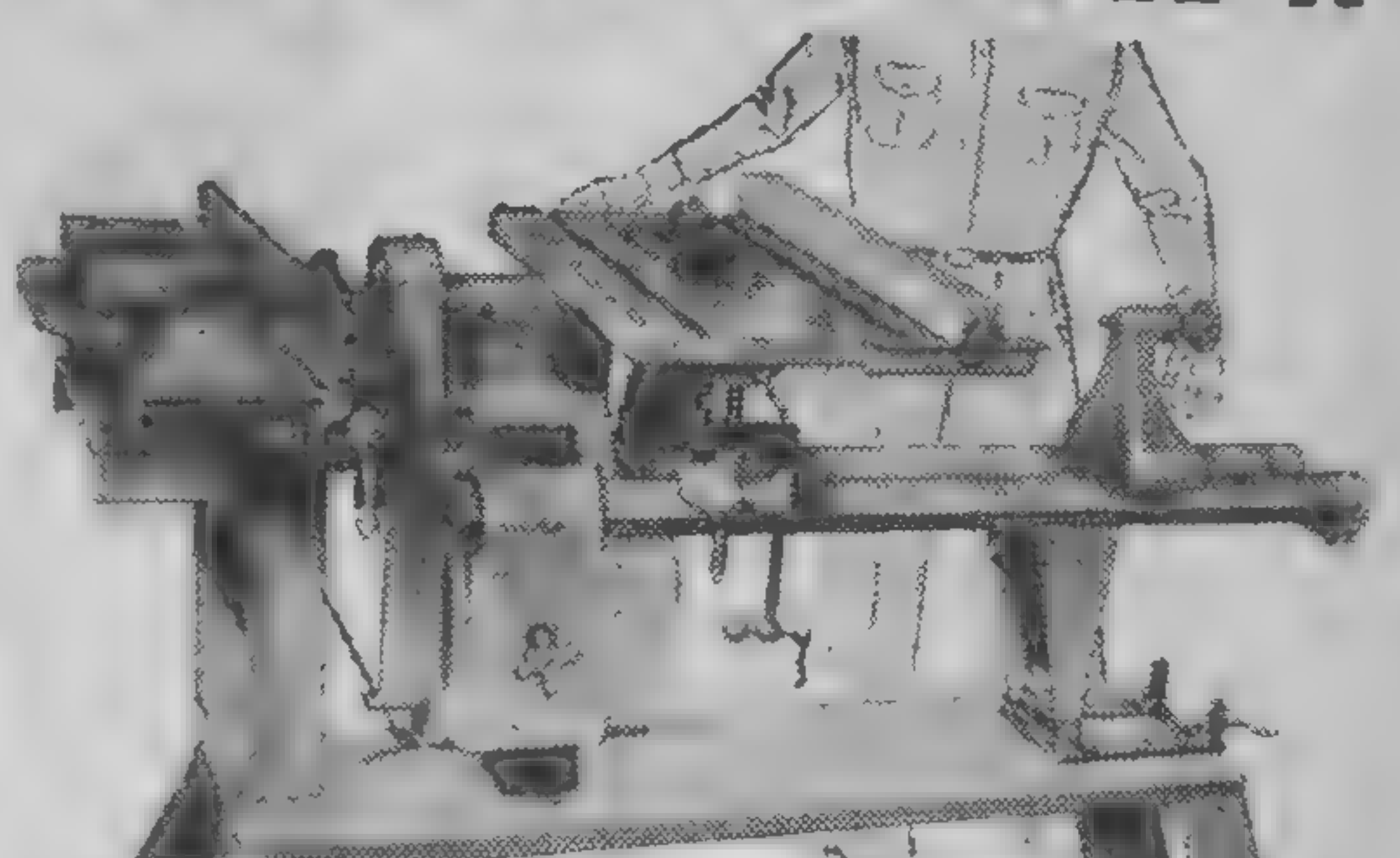
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NAME _____
ADDRESS _____
CITY _____ STATE _____

MATERIALS LIST		
Drill Press Sanding Table		
All dimensions in inches		
No.	Pcs.	Description
1		base
1		table
1		hardwood fence
4		maple or birch dowels
4		spiral compression springs medium tension
8		metal washers with $\frac{13}{32}$ dia. hole
4		cotter pins
2		carriage bolts and wing nuts
2		metal brackets
1		small container, liquid glue

Wood Lathe Sanding Table		
No.	Pcs.	Description
1		base (trim to length after assembly)
1		vertical table
1		horizontal table
2		hardwood braces
1		hinged piece
2		maple or birch dowels
2		hardwood guide blocks
1 pr		butt hinges
12		th screws
1		small container, liquid glue

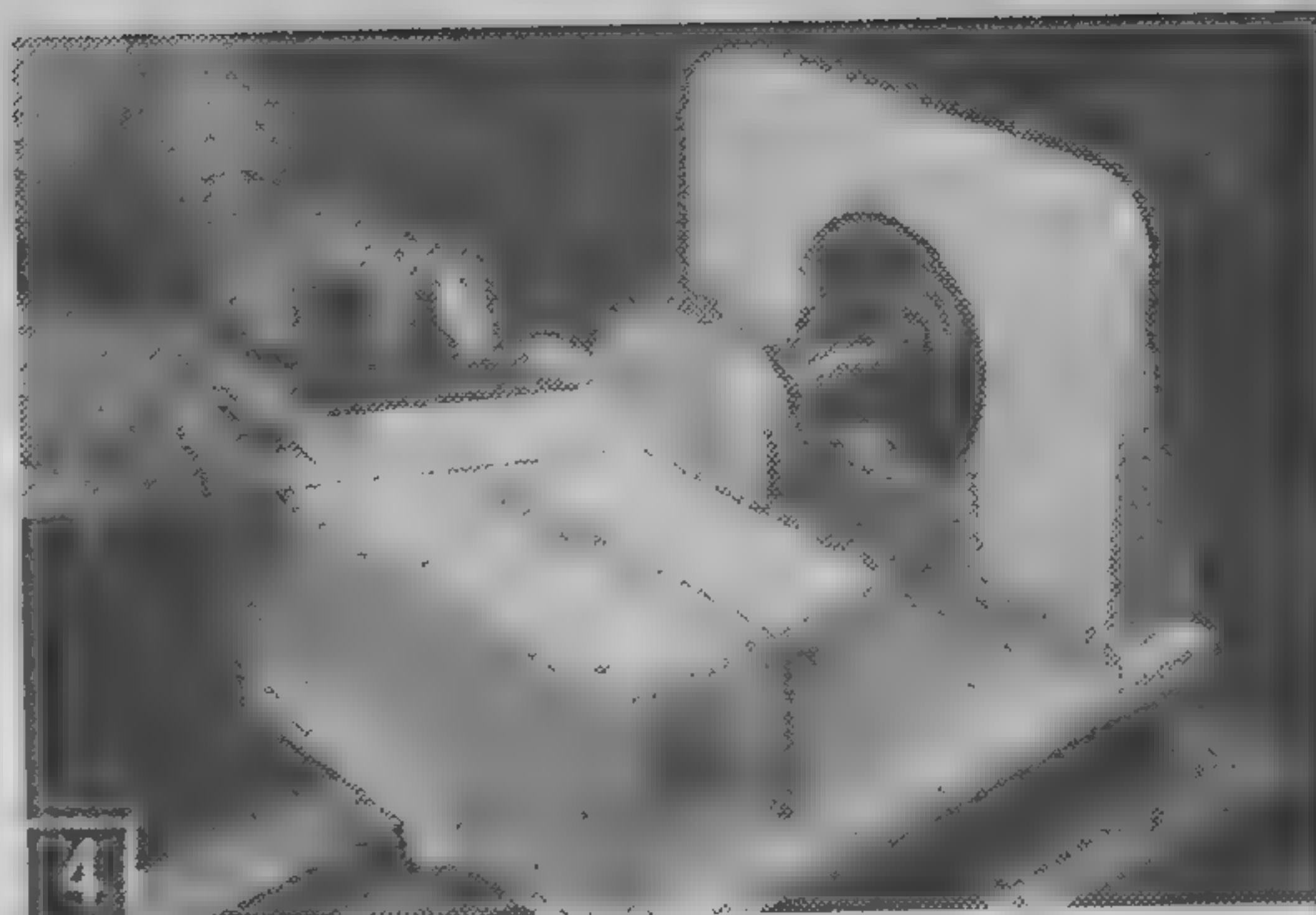
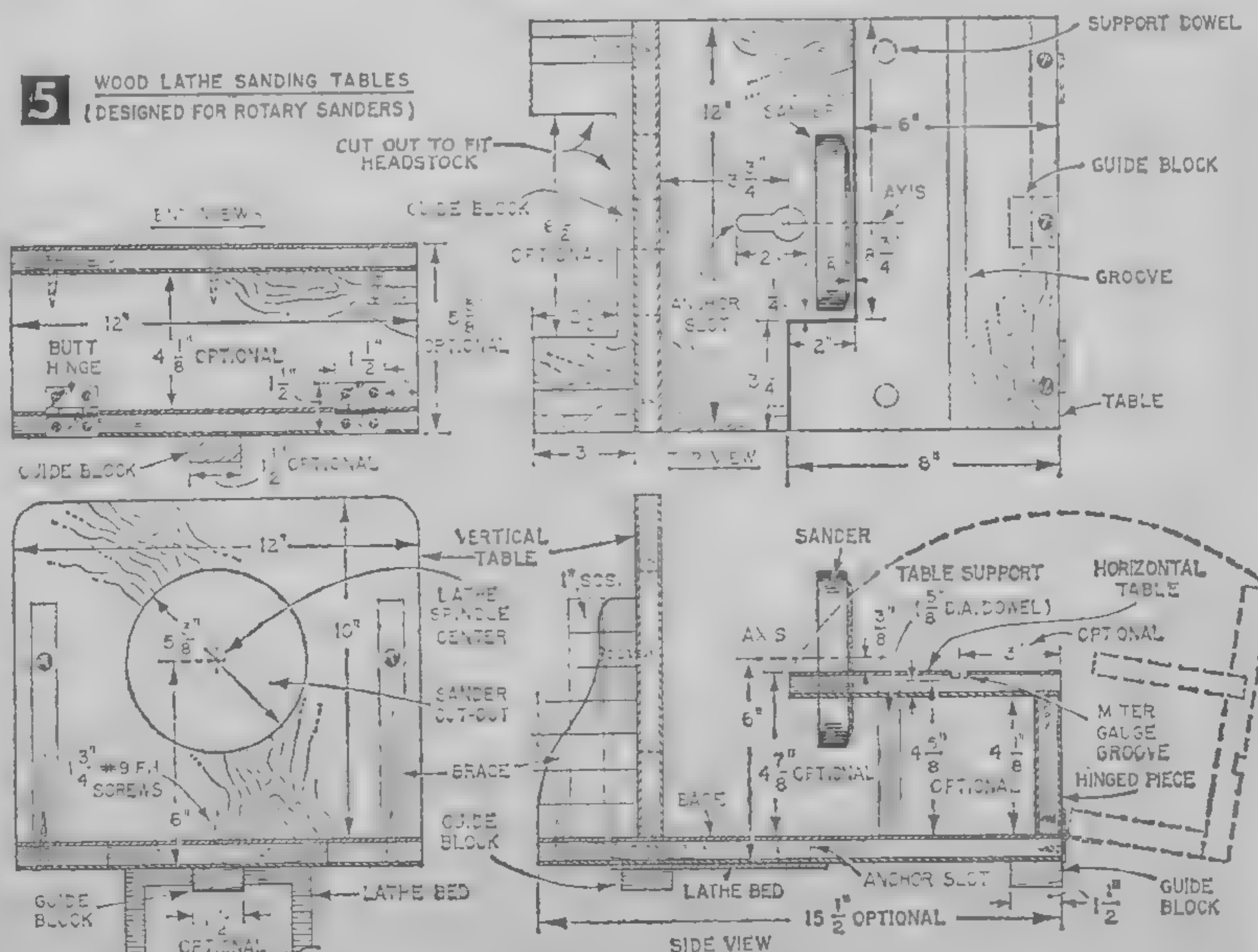
Unless otherwise specified, all parts are cut from $\frac{3}{4}$ " Douglas Fir plywood.
Dimensions accompanied by an asterisk (*) are optional.

In sanding on the drill press, remember that the speed should do the work, not the pressure. Generally the highest speed on your machine will be best for fine work, although sometimes when cutting with heavy abrasive paper, especially on soft stock, the action will be better at low speed because less heat and gumming of the paper occurs.

The Lathe Sanding Table has two uses (Figs. 2 and 4), and is shown mounted on a 6-in. (12-in. swing) lathe. If the spindle of your lathe is not 6 in. above the bed, alter the dimensions of the hinged part and the dowels, so that the working surface of the table is $\frac{3}{8}$ in. below the spindle axis (Fig. 5). The hole for the sander is cut $5\frac{3}{8}$ in. dia. to clear the Kwik-Sand disc, which has a $5\frac{1}{8}$ -in. dia. If you use another type sanding disc, change the hole diameter to suit.

Cut the base from a piece of $\frac{3}{4}$ -in. plywood, and make it about 18 in. long—it will be trimmed later. Depending upon the make of your lathe, you may need to alter the $15\frac{1}{2}$ -in. dimension to suit the overhang of the sander from the headstock. Saw the cut-out shown in Fig. 5, to accommodate the headstock of your lathe, and cut the anchor slot in the base to fit the lathe clamp plate (Fig. 2) which ordinarily holds your lathe tool support. Make the table from the same $\frac{3}{4}$ -in. plywood

5 WOOD LATHE SANDING TABLES
(DESIGNED FOR ROTARY SANDERS)

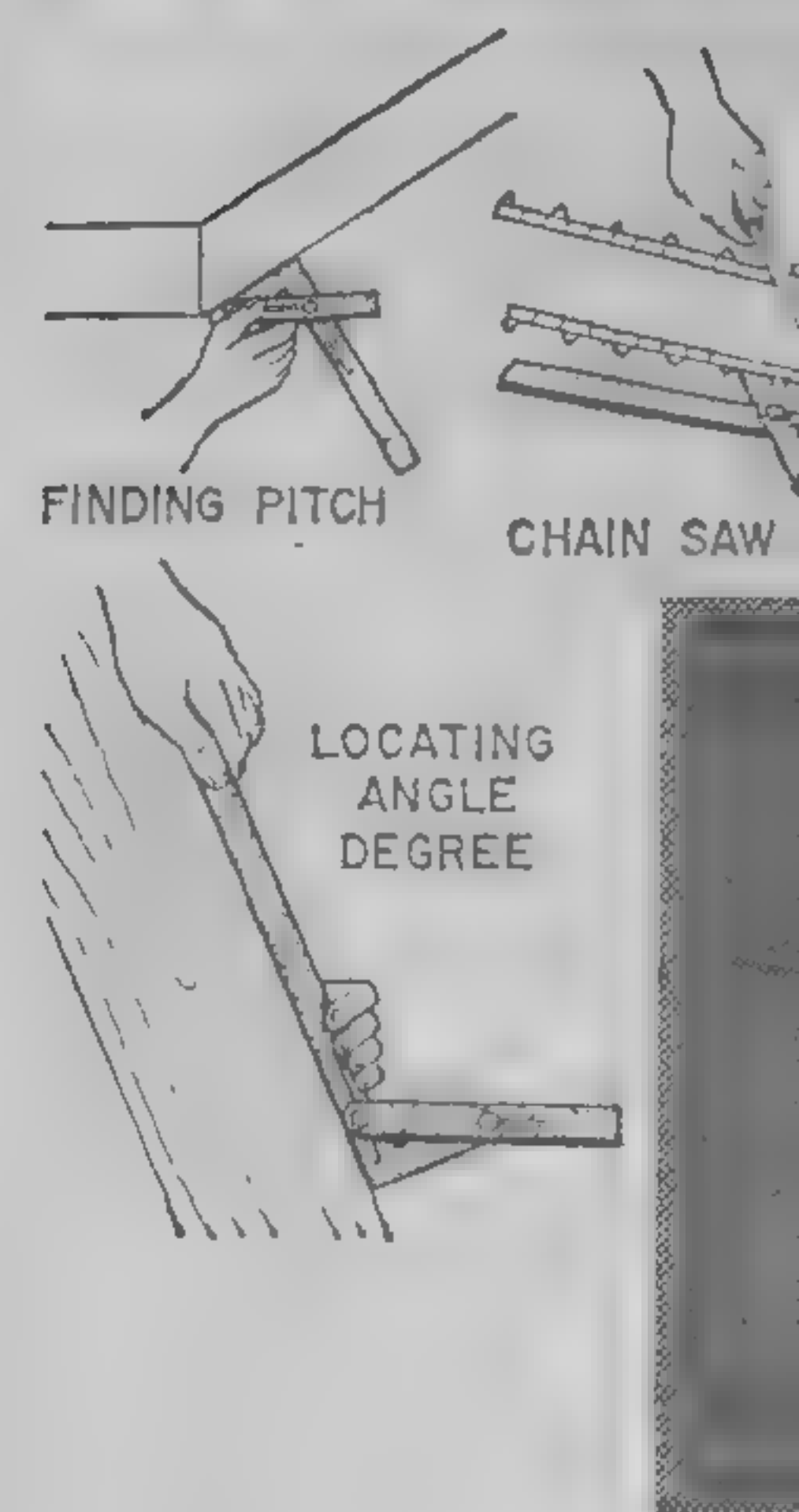


Always edge-sand on the near side of the abrasive disc. If your chuck has a tapered shank, for safety, be sure it is anchored firmly in the lathe spindle.

stock and saw an accurate slot to fit the miter gage from your table saw, or bandsaw. Attach the vertical table and braces to the base with screws and glue. The guide blocks must fit the ways of the lathe accurately, and be mounted so the table will be exactly at right angle to the axis of the spindle. Locate the center for the circular hole in the vertical table by using a nail held in the lathe chuck. Then cut out the hole to fit your sanding disc.

After completing the base and vertical table assembly, bolt it on the lathe with its cutout portion around the headstock (Fig. 4). Place the horizontal table on the base, and mark its outside edge on the end, as a guide to saw off the surplus material. Attach the table unit with butt hinges. Coat all working surfaces with linseed oil to reduce friction, and paint the rest so that it will match the prevailing color scheme of your lathe.—FRANK HEGEMEYER.

New T



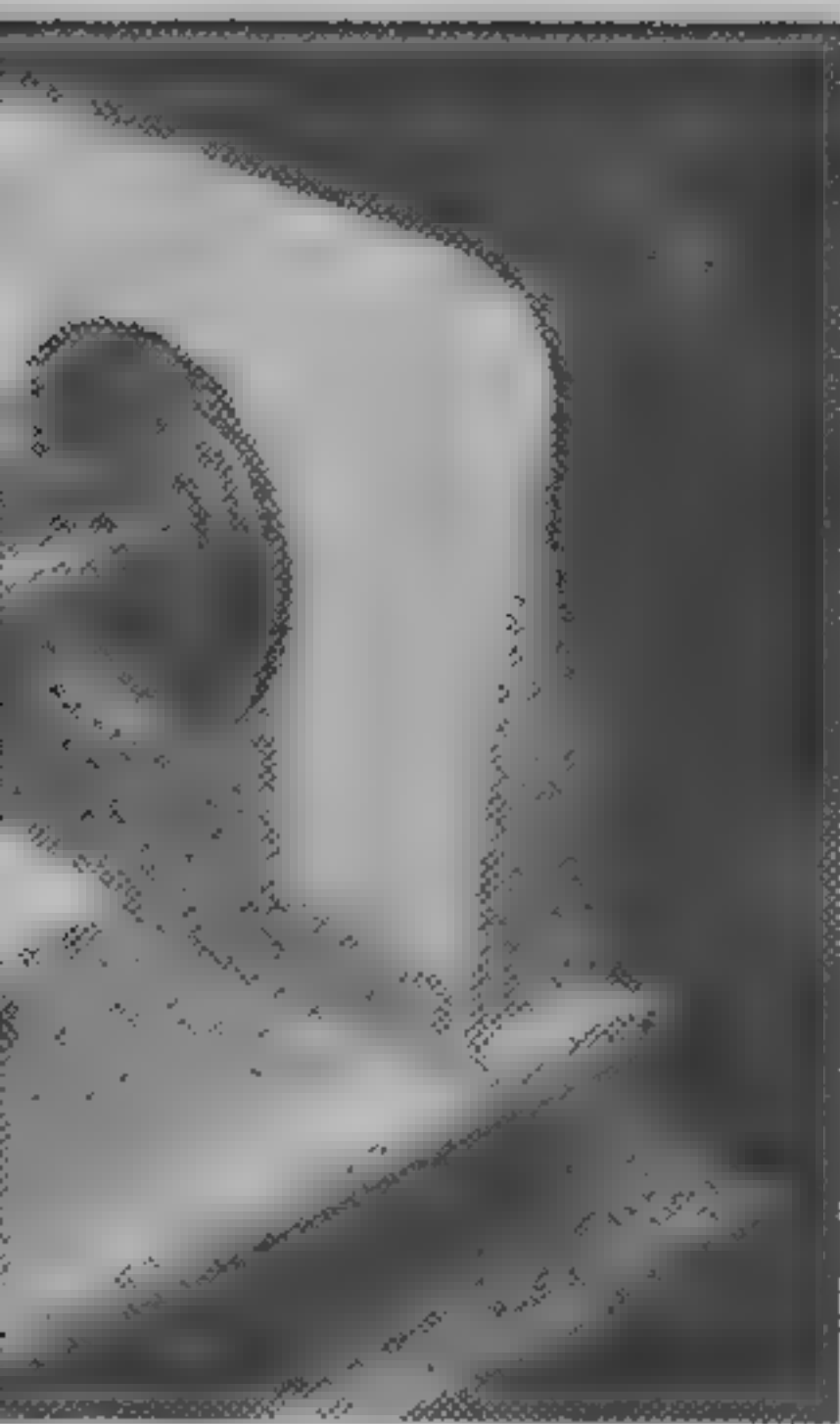
Combination Screw

Driving screws (Fig. 1) use of the Awlscrew, that woodscrew is made the guide ring forward the needle-sharp point is Pressure on the button back in place and the sc Made in England, the handle is red Bakelite. price \$3.95. Available from P.O. Box 52-D, Crouch,

Aluminum S



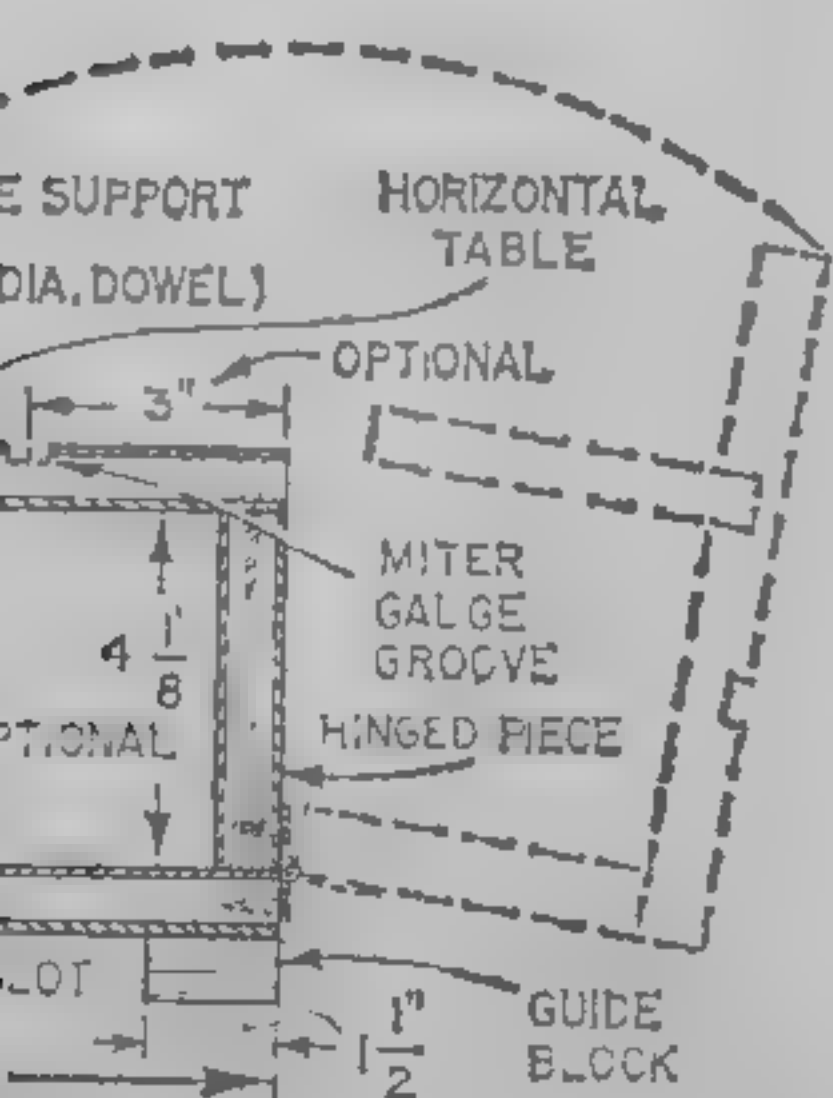
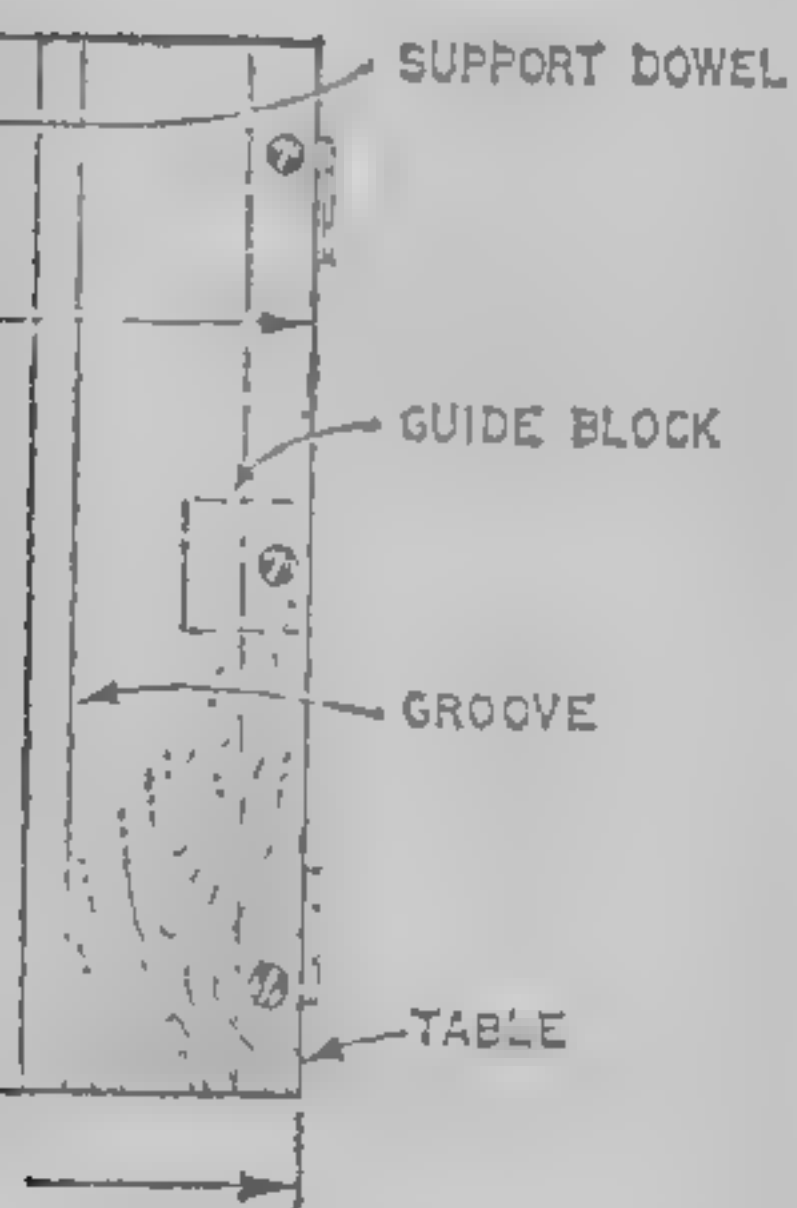
The soldering tool sh long-handled holder o brush. When rubbed th the metal surfaces to be the metal, removing o joint. \$1.98 buys the h solder. Brushes and s arately. Made by the R WRS, Reynolds Metals



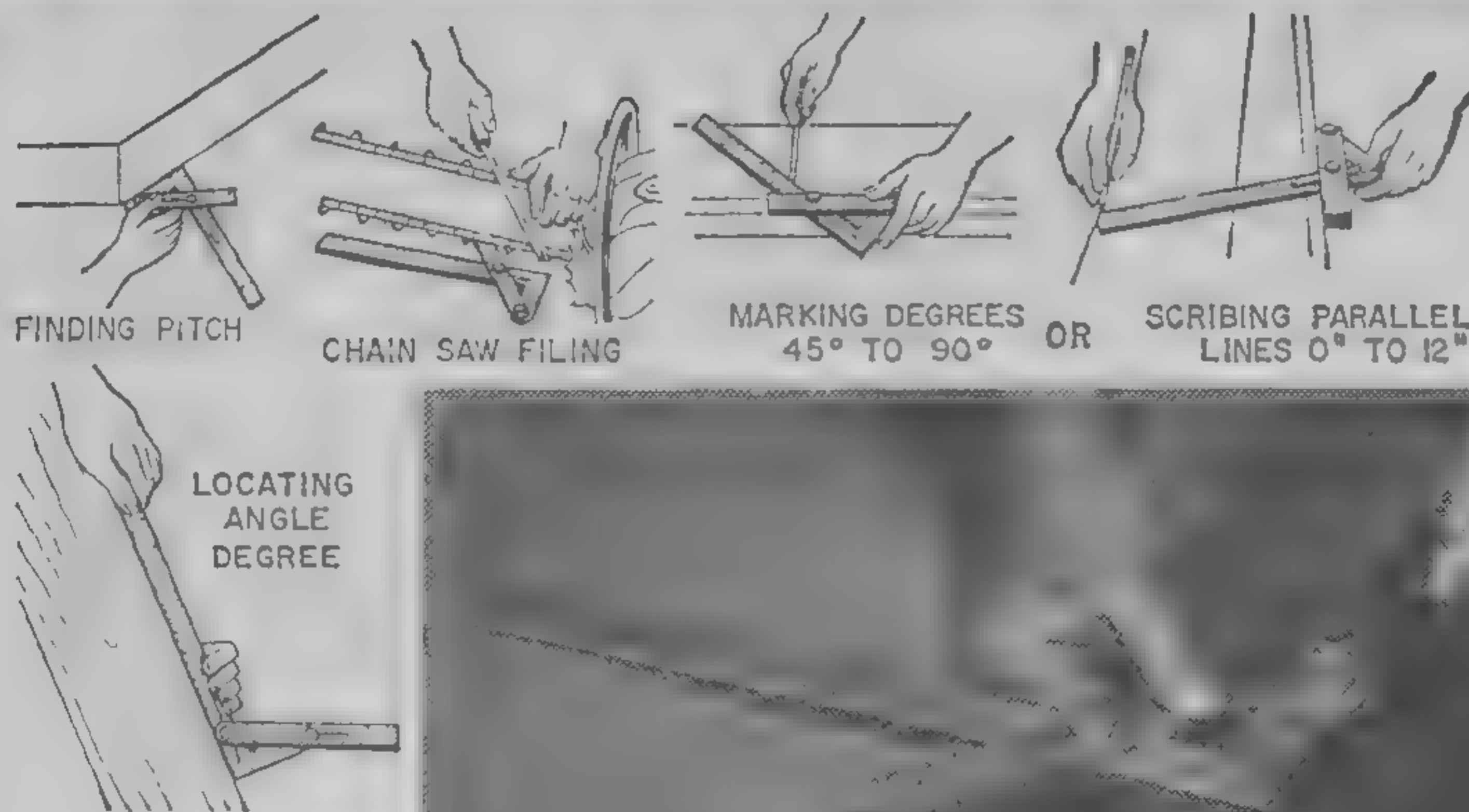
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New Tools for Home Workshops



Multi-Purpose Tool

< While all of the many use of the *Squangle* cannot be listed here, a few are shown in the accompanying illustrations. A combination square-triangle-level, the tool will adjust from 45 to 90°, will measure, level and plumb. Mfd. by The Squangle Corp., Dept. CSC, 6306 176th St., SW, Lynnwood, Wash., the tool is priced at \$4.95.

Combination Bradawl and Screwdriver

Driving screws (Fig. A) is the most frequent use of the *Awlscrew*, but the starting hole for that woodscrew is made by the awl. Just push the guide ring forward about an inch and the needle-sharp point is ready for use (Fig. B). Pressure on the button causes the awl to spring back in place and the screwdriver is again ready. Made in England, the tool is cadmium finished; handle is red Bakelite. Overall length, 8⁵/₈ in., price \$3.95. Available from the Robert Webb Co., P.O. Box 52-D, Crouch, Idaho.



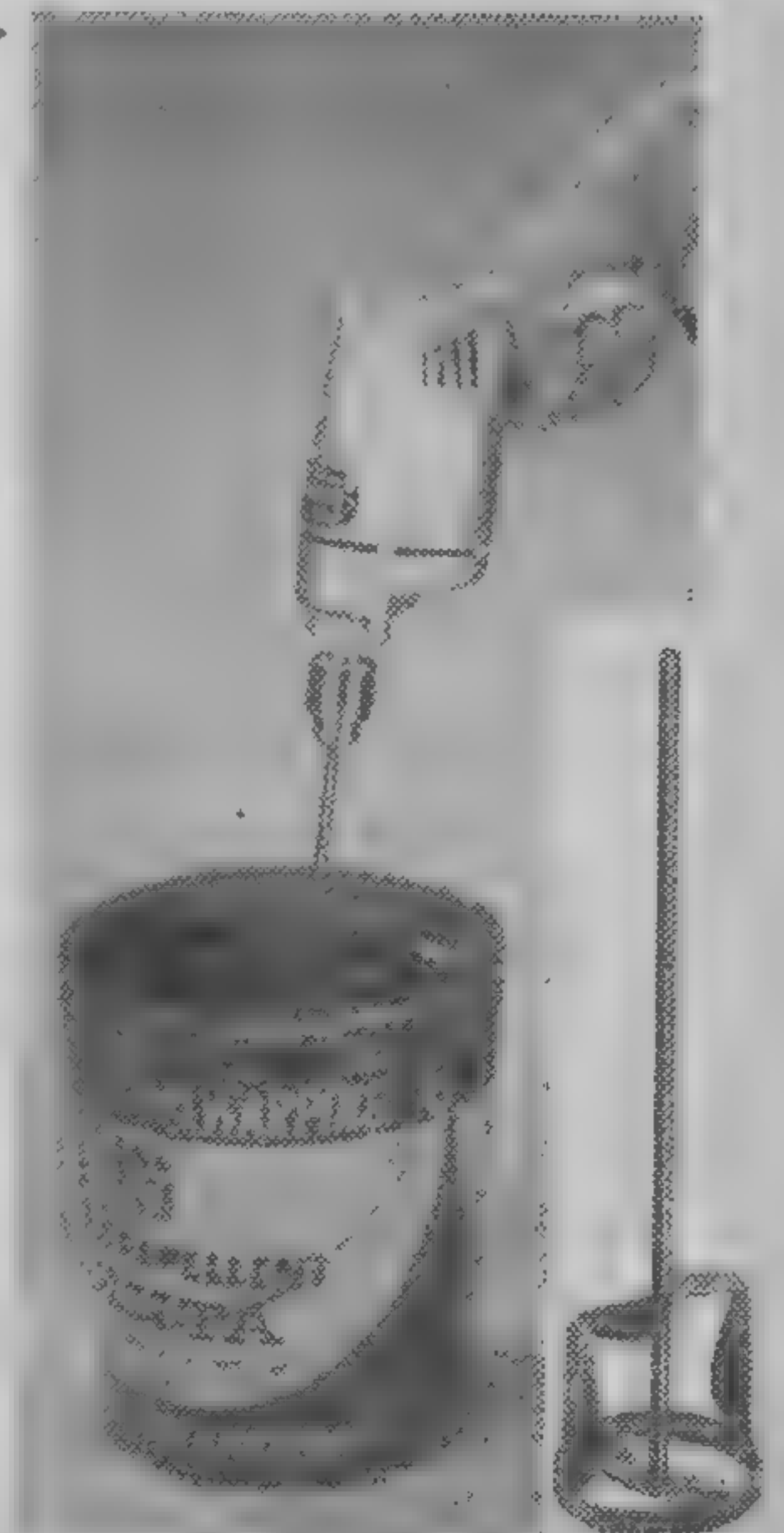
Aluminum Soldering Tool



^ The soldering tool shown above consists of a long-handled holder containing a glass-fiber brush. When rubbed through molten solder on the metal surfaces to be joined, the brush abrades the metal, removing oxide for a firm, smooth joint. \$1.98 buys the holder, two brushes and solder. Brushes and solder are available separately. Made by the Reynolds Metals Co., Dept. WRS, Reynolds Metals Bldg., Richmond 78, Va.

Power Mixer

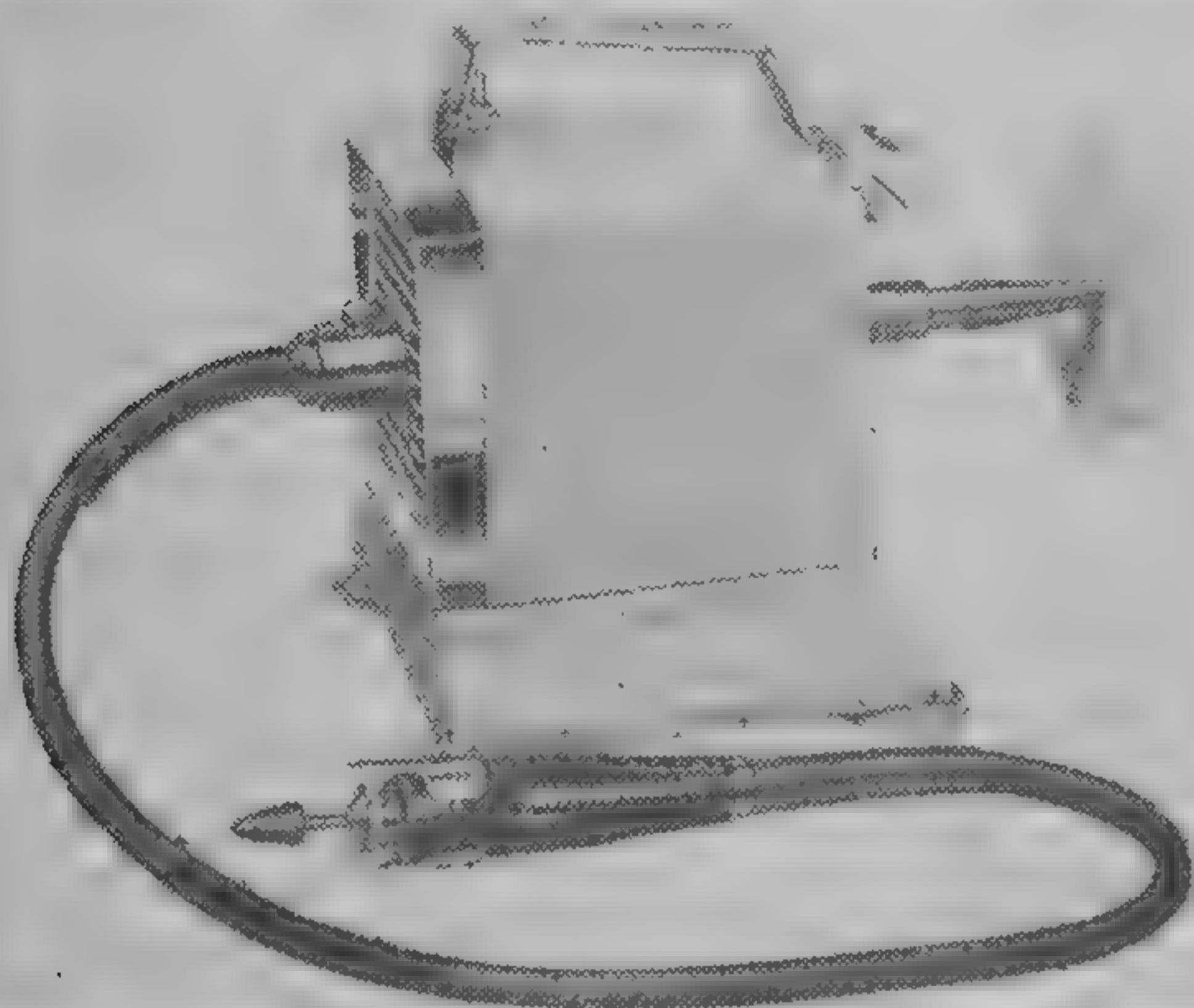
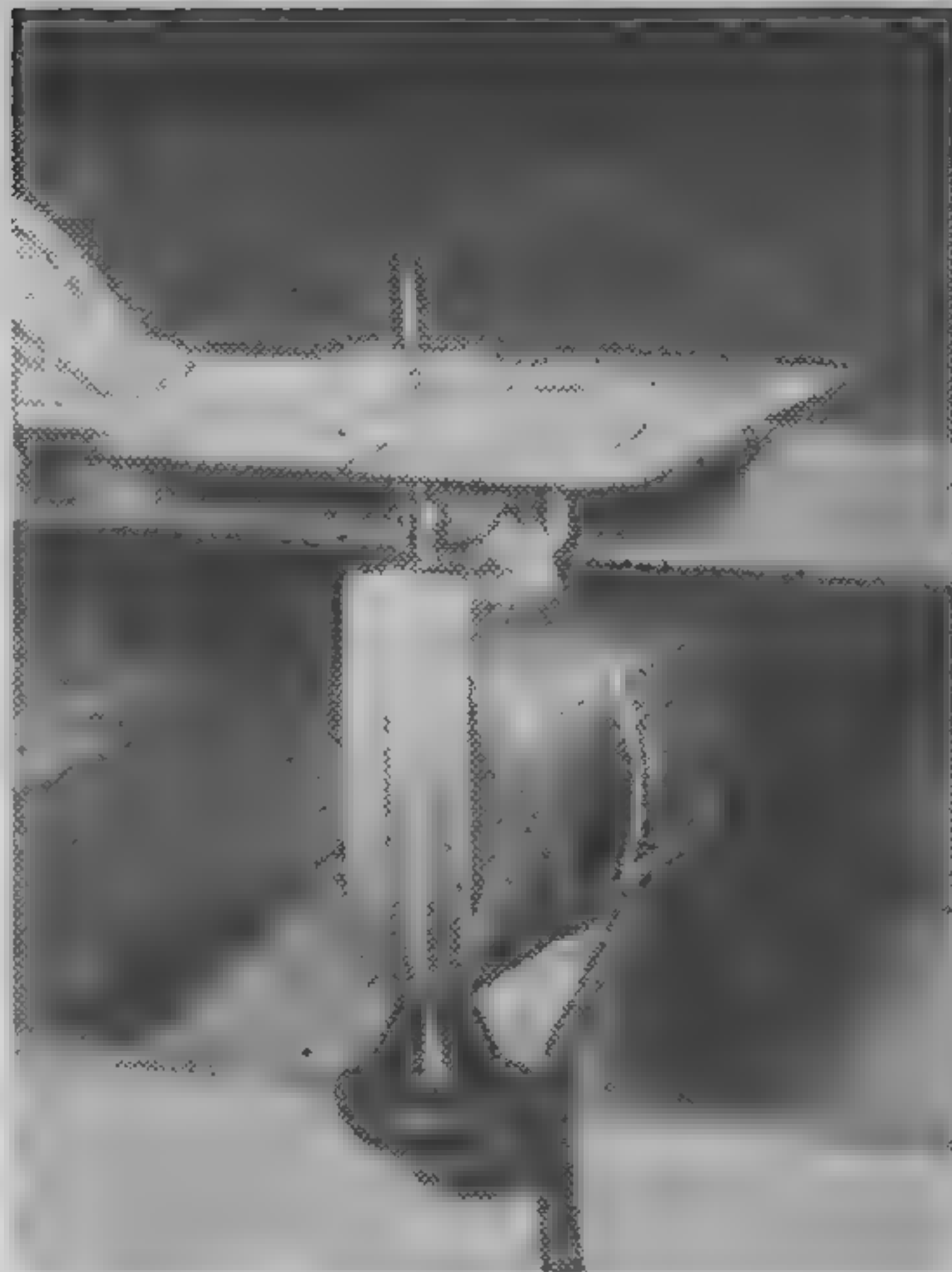
Whether you must mix mortar, plaster or paints, you can trust the job to the model *H Jiffy Mixer*, fitted into any power tool with a 1/4- or 1/2-in. chuck. There will be no splashing and any semisolid deposits will be broken down and mixed with the balance of the material. Mixer is constructed of copper-nickel plated 18-gage carbon-steel plate welded to a 1/4-in. steel drive shaft. Priced at \$2.95, the mixer is made by the Jiffy Mixer Co., Dept. RC, 515 Market Bldg., San Francisco 5, Cal.



Portable-Stationary Jig Saw Combo

A small steel table furnished with the No. 17 *Speedway* portable electric jig saw (\$29.50) converts the saw into a stationary jig for intricate scrollwork and irregular cutting (left).

Just screw the table to the edge of the workbench (right), and attach the inverted jig saw with locking nut and bolt. Though the table remains a part of the bench, the saw is quickly removed for portable use. Mfd. by Speedway Div., Thor Power Tool Co., 1421-A Barnsdale Rd., LaGrange Park, Illinois.

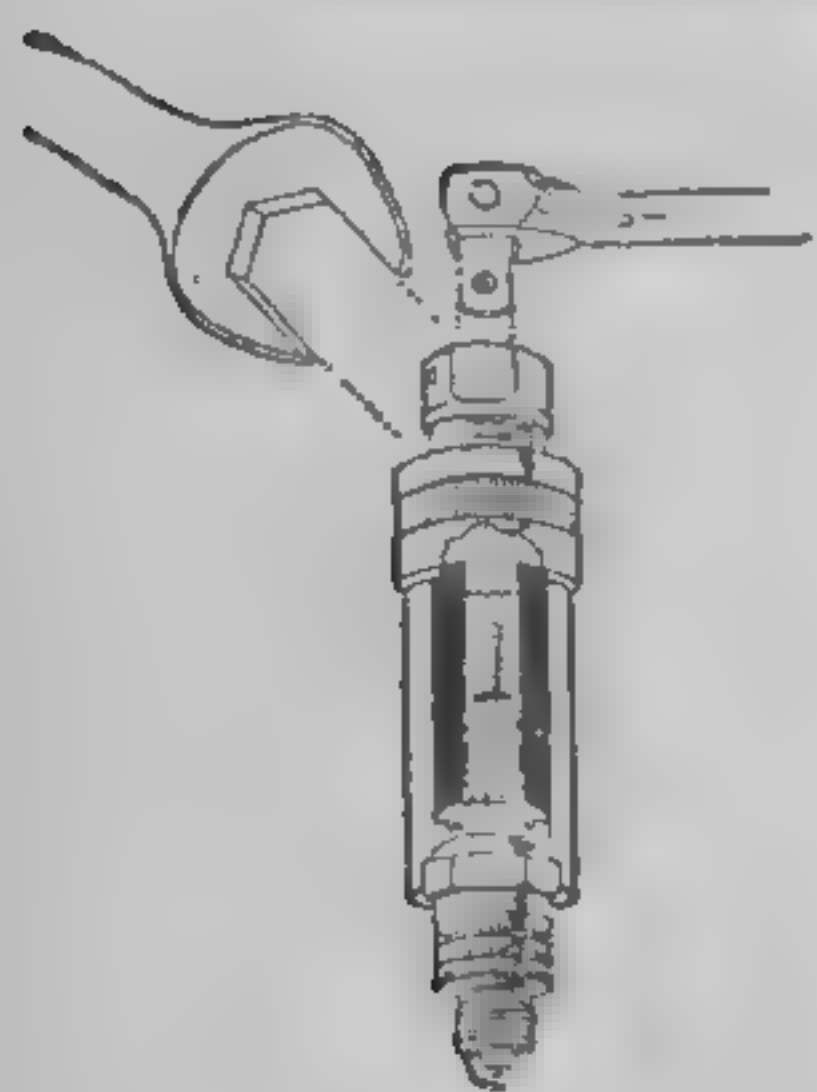


Accessories Keep This Tool Humming

< The power unit of the *Flex-O-Tool* is a high torque a-c motor delivering 3450 rpm. As shown in the photo (\$37, less buffing wheel and wheel point), the tool is fitted with a 40-in. flexible shaft attachment which terminates in a nylon hand piece that does not heat up under long use. Opposing side is fitted with a tapered spindle which holds polishing or buffing wheels.

Equipped with just the flexible shaft attachment and $\frac{1}{8}$ and $\frac{3}{32}$ -in. collets, the unit is priced at \$34.50. Accessories are available for grinding, drilling, carving, polishing, sanding, engraving. Shaft also accommodates a $\frac{1}{16}$ -in. collet; with an adapter it will hold No. 60-80 drills. If desired, power unit can be obtained with right- and left-hand tapered spindles at \$27.55.

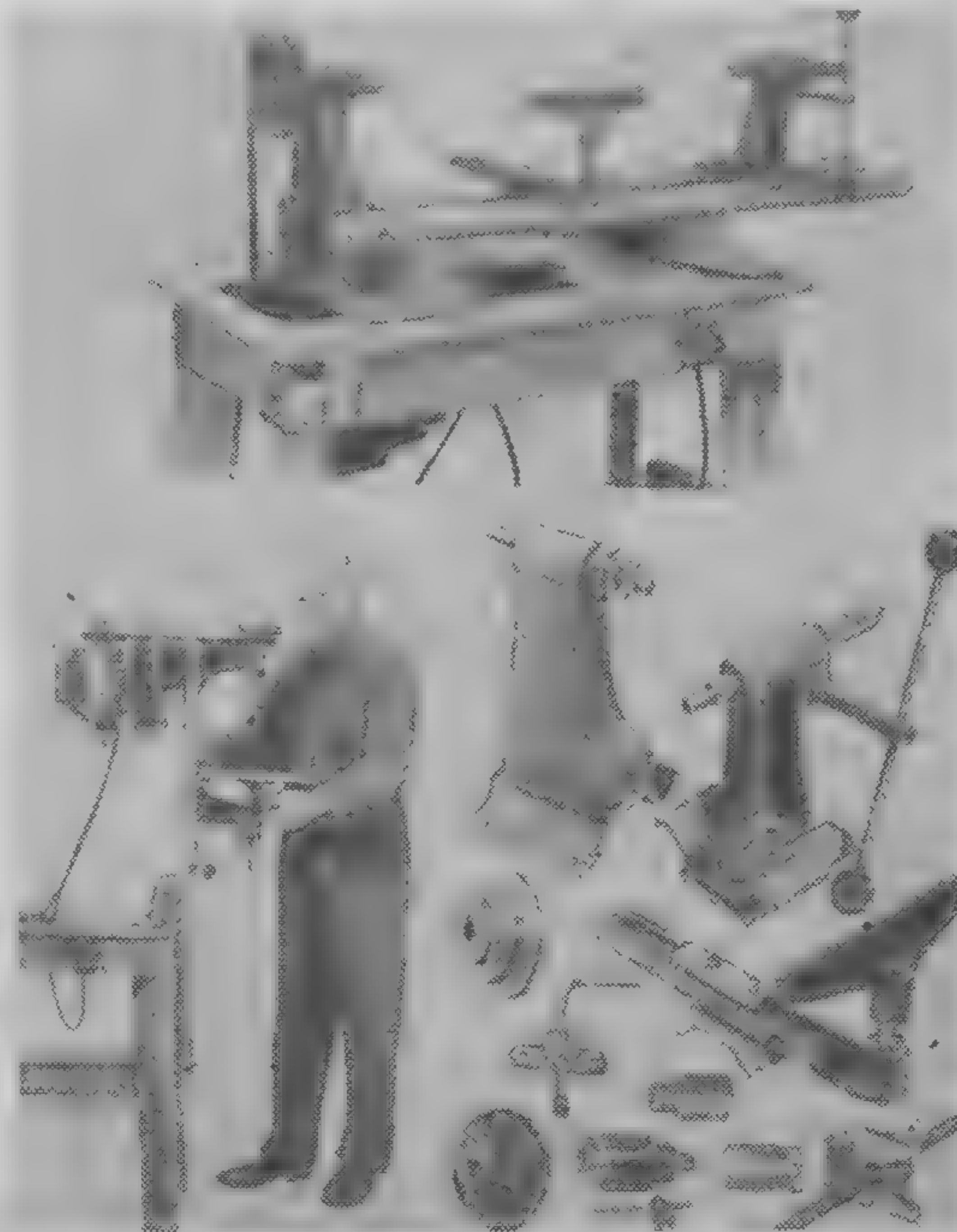
Ratcheting Spark Plug Tool



< A holding socket, reversible ratchet and short extension are combined in this spark plug tool. Torquing of the plugs is possible under all conditions. Priced at \$6.95, the tools are made by Herbrand Tools, Dept. SRI, Fremont, Ohio.

Drill Press-Lathe Kit

By combining the parts contained in this \$29.95 kit with a wood frame, an iron pipe bed, and a $\frac{1}{3}$ hp motor, you can have a wood lathe that features three-speed spindles with New Departure ball bearings, rack and pinion feed tailstock and 8-in. graduated tool rest. Lathe capacity is 12-in. swing, 31 in. between centers. Bed locks in vertical position for use as a drill press which will handle a $\frac{1}{2}$ -in. bit in steel and drills to the center of a 12-in. circle. Mfd. by Gilliom Power Tools Mfg. Co., Dept. SC, 1109 No. Second St., St. Charles, Mo.



PATENT

Strain



By ALAN M
Patents

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PATENTS & INVENTIONS

Straight Answers to Your Patent Questions



By ALAN MONTAGUE

Patents Editor

IF THE mail this last week or so is a fair sample, you inventors really have more than your share of troublesome problems. And some of your questions have more curves to them than anything that ever came out of Hollywood.

Well, let's see what we can produce in the way of helpful advice. Question No. 1 coming up:

Mail Order Coin Counter?

I have a patent on a coin stacker and counter, and wish to have the item manufactured so I can sell it by mail order. Your advice?

This is not properly a mail order item, and you will go broke trying to sell it by mail order. Correctly, this is a sideline item for some company which has a sales force already calling on banks. Ask a couple of bankers what suppliers they consider to be most aggressive, and then go after these suppliers.

Want New Inventions

We are manufacturers, and the demand for our product is petering out. How can we best get some new inventions?

Write to the various patent brokers, telling them what facilities you have, and what your distribution set-up is. Also, check in with the Small Business Administration, 811 Vermont Ave., N.W., Washington, D. C.

Determining Demand

I am making my gadget on a very small scale in my basement workshop, and have passed out a few samples. All the women in the neighborhood say they want one, but I haven't seen any of them beating a path to my door to pay cash. How can I really determine public demand?

This is a very interesting and commonly-en-

countered situation. Everybody will say they want one, just to be polite, but when it comes to buying, that is apt to be another matter. Your best bet is to run some ads under "Agents Wanted"—sell samples to the agents—and wait for orders and re-orders. If and when you get a stack of re-orders, you will know that you have a good item, and you should encounter little difficulty in lining up a manufacturer on a nice royalty deal. Incidentally, it may be wise to have the literature you mail to prospective agents prepared by an advertising agency specializing in the field.

Unusual Kite

I have a kite of unusual design which won't fly unless it is made just so, but the examiner can't get it through his head, and has given me a final rejection on the grounds of theoretical aerodynamics. What do I do next?

You could appeal, but the statistics show that the inventor rarely wins these imbroglios, so I would suggest that you try for a design patent or a copyright, or both.

Get Your Money Back?

How much of my money do I get back from the patent attorney and from the government, if my patent is not granted?

Nothing. The government filing fee is not refundable. As to the attorney fee, if the thing has been battled through to a final rejection, the attorney has spent far more time and effort than he would in an application which was speedily allowed. In all matters relating to patents and inventions, you pay for services and not for results. If you stick in a poker game on two pair, you can hardly expect the man with a full house to give you your money back.

Pay Later Plan?

I have a patent on a good invention, but the manufacturers I have talked to want to make the invention now and talk about money later. I don't like this kind of a deal. What do you suggest?

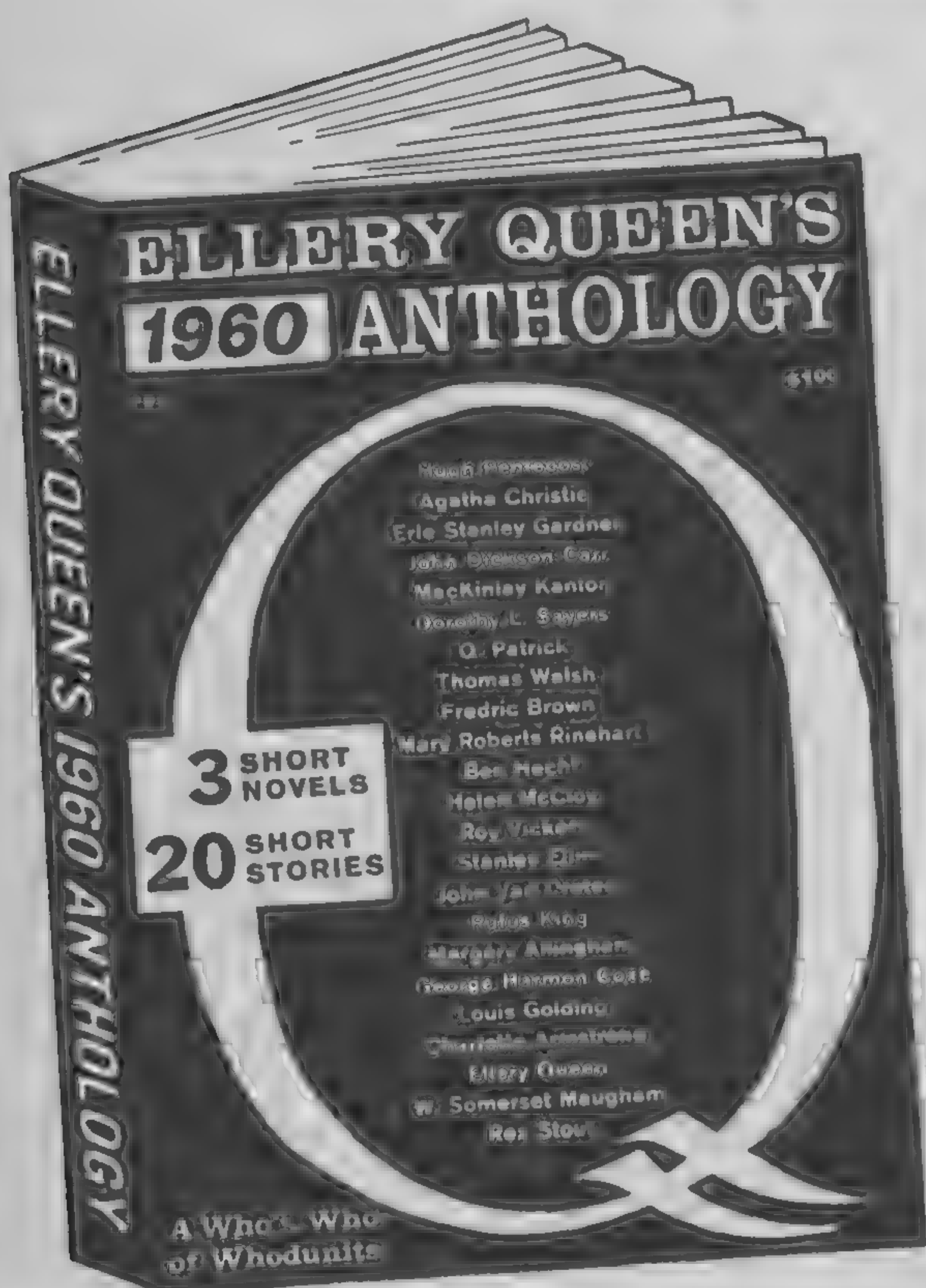
Quite frequently manufacturers just won't pay you any cash down, and that's that. They feel, perhaps justly, that they are going to spend thousands of dollars, and that you are not entitled to any dividends until they start to make some. In



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—Anthony Boucher, *The New York Times*

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The official answer is, in every case, no. However, one inventor recently decided to use it. One who had to go to the Pentagon and what everybody else decided wouldn't be doing if it were to file a patent application with the National Inventors' Council because (a) it takes steps to protect yourself, some officer who may be on the Council knows how and invention around through

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these circumstances, I suggest you get a lawyer to draw up an agreement whereby they will have an exclusive right to make and sell the invention—the right to be forfeited unless they start paying you a 5% royalty out of the proceeds of bona fide sales of the item within three years. This will force them to keep active, and prevent them from playing dog in the manger. And don't, just because you happen to have a patent, be hard to get along with; don't cut off your nose to spite your face. Remember your patent isn't worth a whoop in a whirlwind unless it is being worked, so go along on a mutually reasonable basis.

Will the U. S. Pay for a Patent?

Can I get Uncle Sam to pay for my patent?

The official answer is, in general, "No." However, one inventor recently told me that an officer in the Patent Section of the Army in the Pentagon said that the Army might pay for a patent on one of his inventions, provided they decided to use it. One way you can find out is to go to the Pentagon and ask: otherwise, do what everybody else does (and which they wouldn't be doing if it weren't apparently best); file a patent application and submit a copy to the National Inventors' Council. This is the best proposition because (a) you are taking legal steps to protect yourself, instead of dealing with some officer who may be overruled, and (b) the Council knows how and where to shop your invention around through government bureaus.

Give Searcher a Drawing?

I have told a searcher what my invention does, and sent him my money, so now he wants me to send a drawing. What's the matter with him?

There is nothing wrong. Patents are not granted upon purpose or function, but upon the specific structure by which the purpose or function is achieved. Consequently, the searcher cannot possibly do right by you unless you give him a structure on which to base a search. Of course, he could pick out a half dozen sample patents from different subclasses, but such a search would be virtually meaningless, and could lead you into some very costly blunders which you would bitterly regret. So, by all means, send the man a drawing, however crude.

Floor Mats from Old Tires?

I have purchased machinery for making woven rubber floor mats out of old auto tires. I would like to sell through agents, and could give them a 25% to 30% commission. How do I go about it?

Your item is not hot enough, and your commission is not long enough to interest agents. You should have something with some real novelty to it, and the commission must be at least 50% before you can expect anybody to pound the pavements for you. Sell the machinery for what you can get; chalk your loss up to experience; and think up something really new and thrilling.

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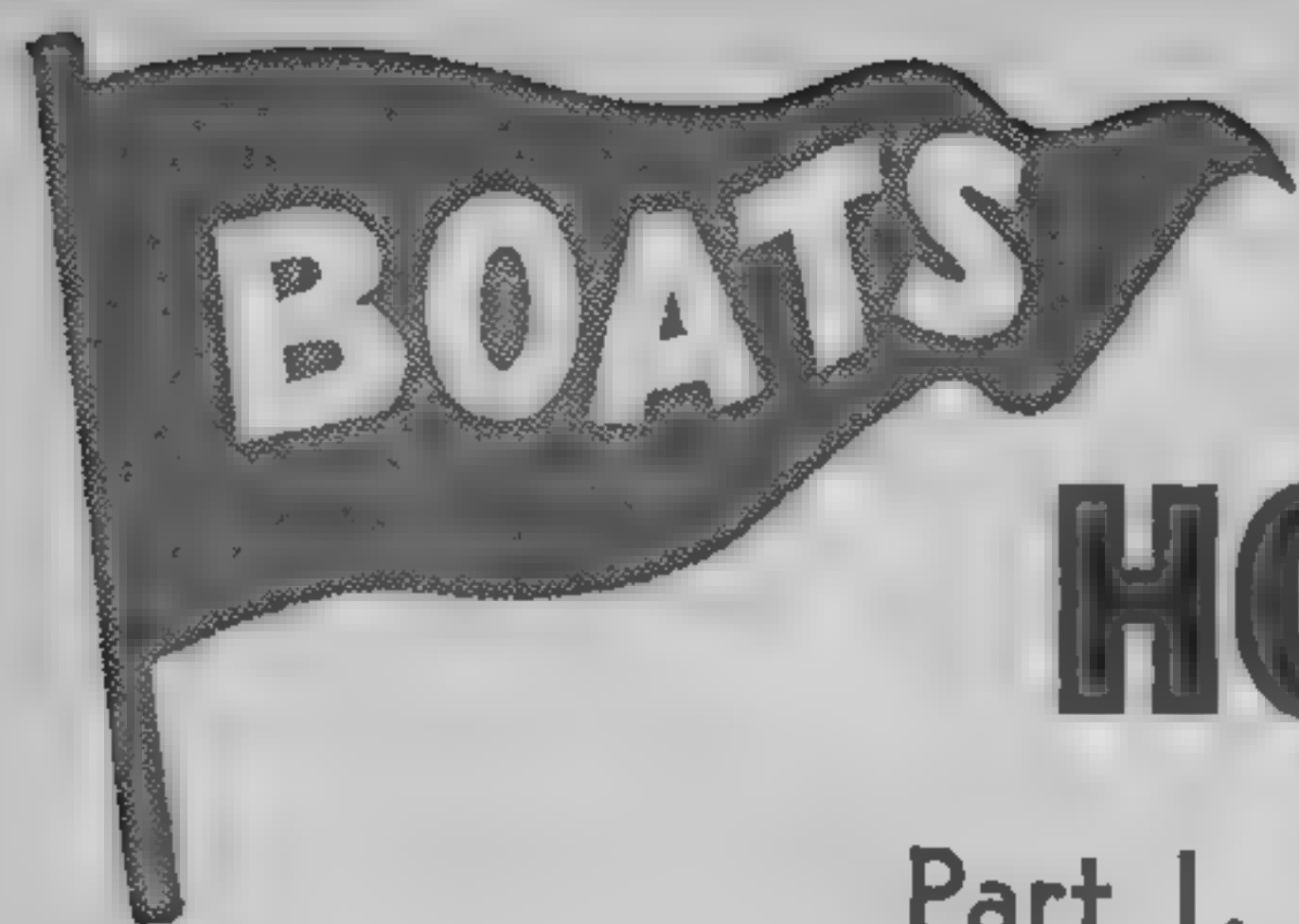
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More Speed—More Stability With HOME-BUILT HYDROFOILS

Part I. Want a faster boat? Or greater stability on rough water? If so, this willing mermaid is for you

BECAUSE hydrofoils lift the entire boat hull above the surface of the water, they will usually increase the speed of a boat-and-motor combination by 25%.

Rough waves that will rock a conventional hull do not affect hydrofoils, which ride below the surface. Thus you have greater stability and a smoother ride with hydrofoils. And maneuverability at high speeds is good, because the foils don't skid on the water.

The building plans for the hydrofoils shown in this article are the result of designing and testing many different types, sizes and shapes of hydrofoils over a period of several years. Detailed plans for building the specific boat with which we tested these hydrofoils will be given in Part 2. You can, however, use these hydrofoils on most any boat up to 16 ft. in length. Some experimentation as to placement of the two forward hydrofoils on any other boat will, of course, have to be worked out by a series of test runs for best performance. But more about that later. Right now, let's get started with the construction of the hydrofoils.

Making a Set of Hydrofoils. The set consists of three separate hydrofoils: two of them mounted on opposite sides of the boat hull up forward as in Fig. 2 and one foil fastened to the transom. All foils may be swung up clear of water so that boat can be beached as in Fig. 5.

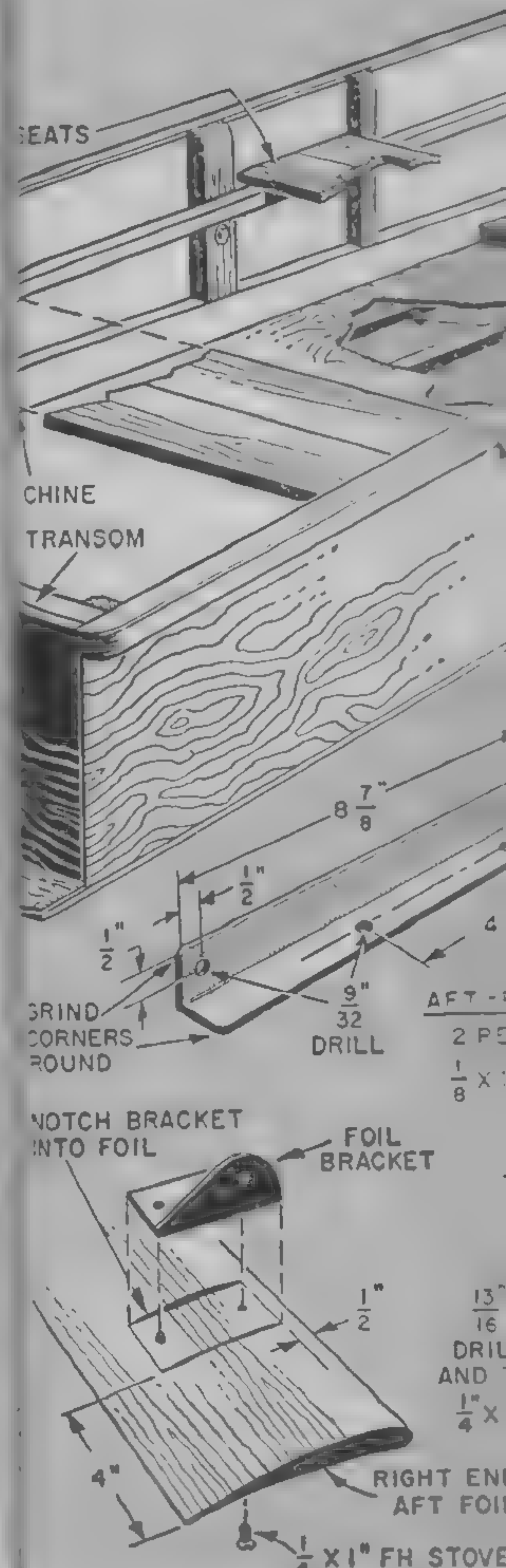
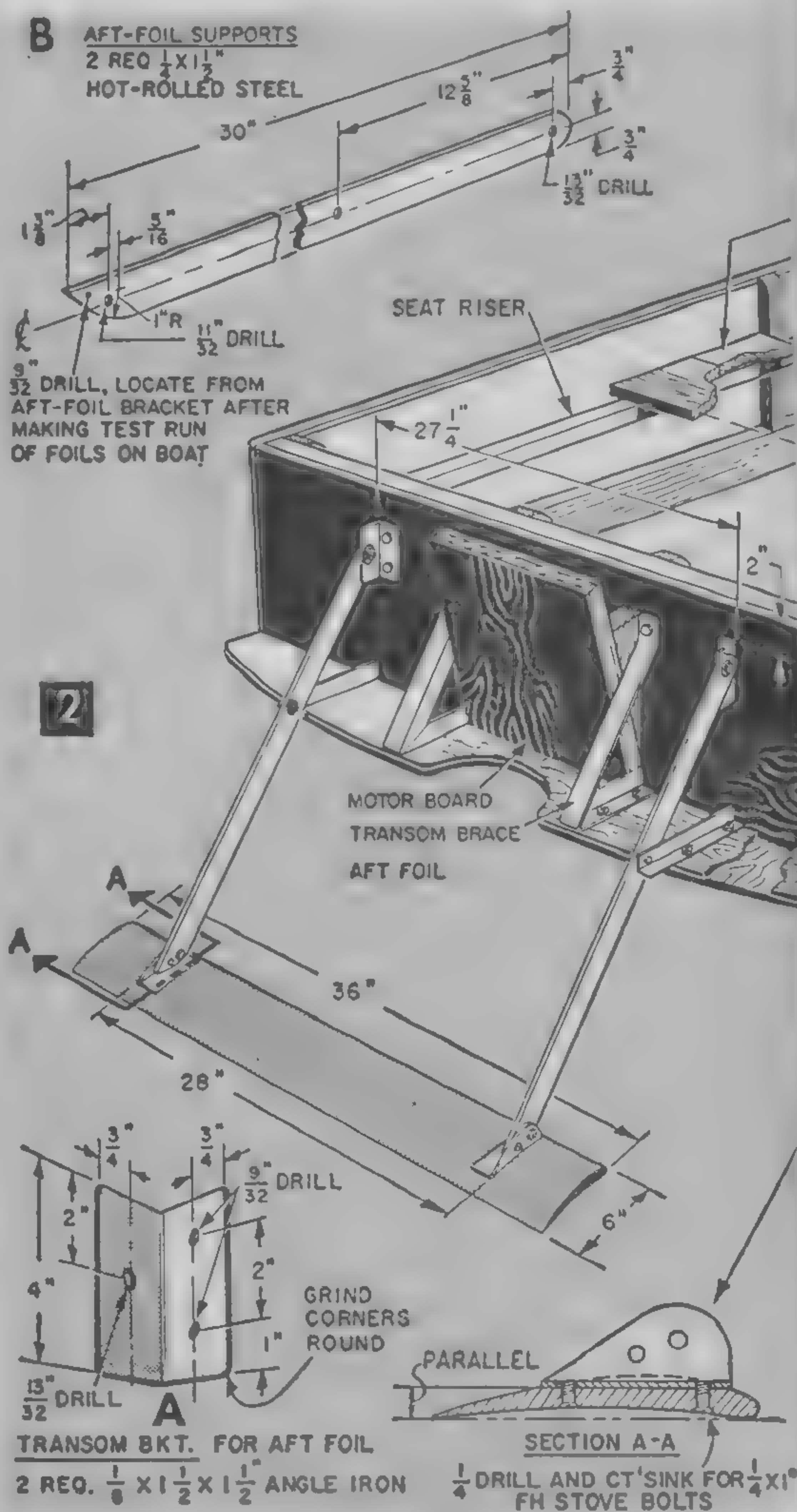
Starting with the transom or aft foil make the metal parts detailed in Figs. 2A, B, C and D. If these hydrofoils are to be used on a boat other

By WILLIAM D. JACKSON

Naval Architect

Craft Print Project No. 304

than the one shown here, you may have to alter the design of the aft-foil support bracket (Fig. 2C), by putting a 90° bend on it for fastening directly to the transom instead of to the projecting ends of the bottom planking as on our boat. The other parts should work well on any boat. Where



STATEMENT OF USES

USES: Experimental outboard powered boat and hydrofoils for testing speed increase, load carrying capacity and maneuverability of hydrofoil equipped boat. Boat may also be used without foils for sport and fishing use.

BOAT: Flat bottom, scow-type hull with battened air traps on bottom to aid foils in quickly lifting boat from surface of water.

HYDROFOILS: Steel framework with fiber glass, air-foil shaped lift surfaces. Foils are retractable.

POWER: 10 to 40 hp long-shaft outboard motors, 18 hp Evinrude '59 long-shaft motor used in making test described.

BOAT LENGTH: 10 ft. **BOAT BEAM:** 4 ft.

BOAT WEIGHT: 200 lbs. with foils and all equipment.

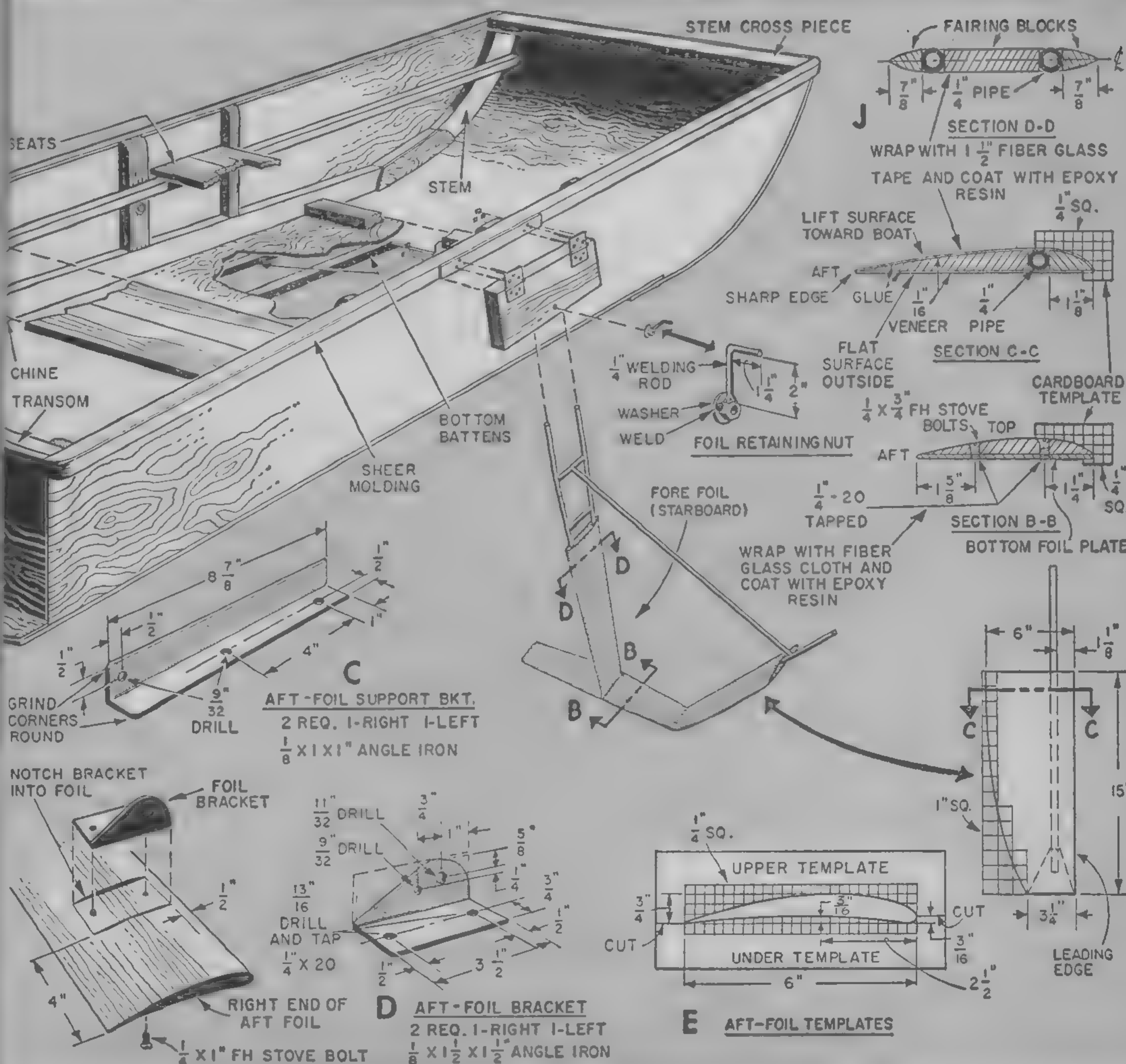
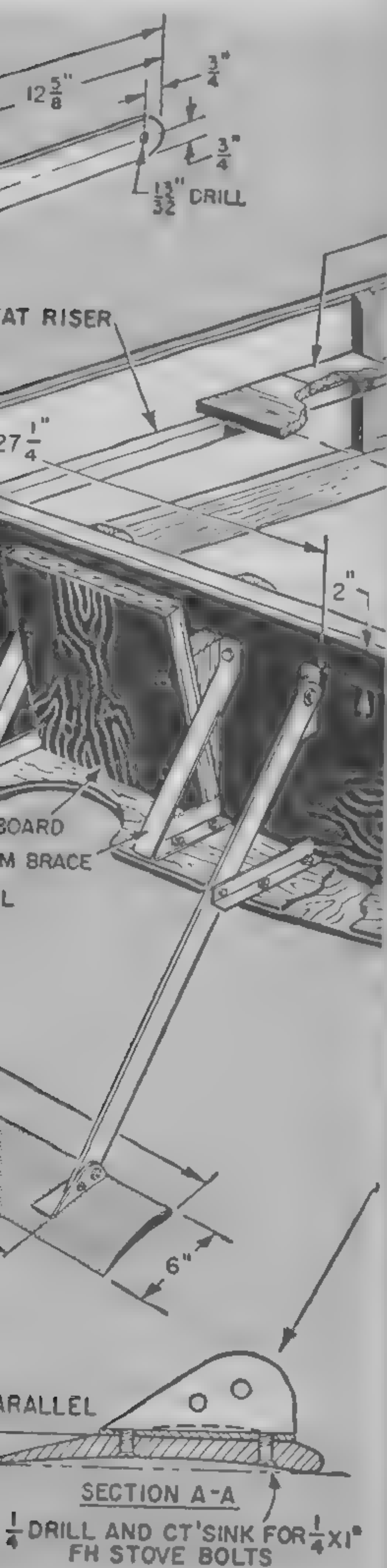
BOAT CAPACITY: 3 with foils, 4 without foils.

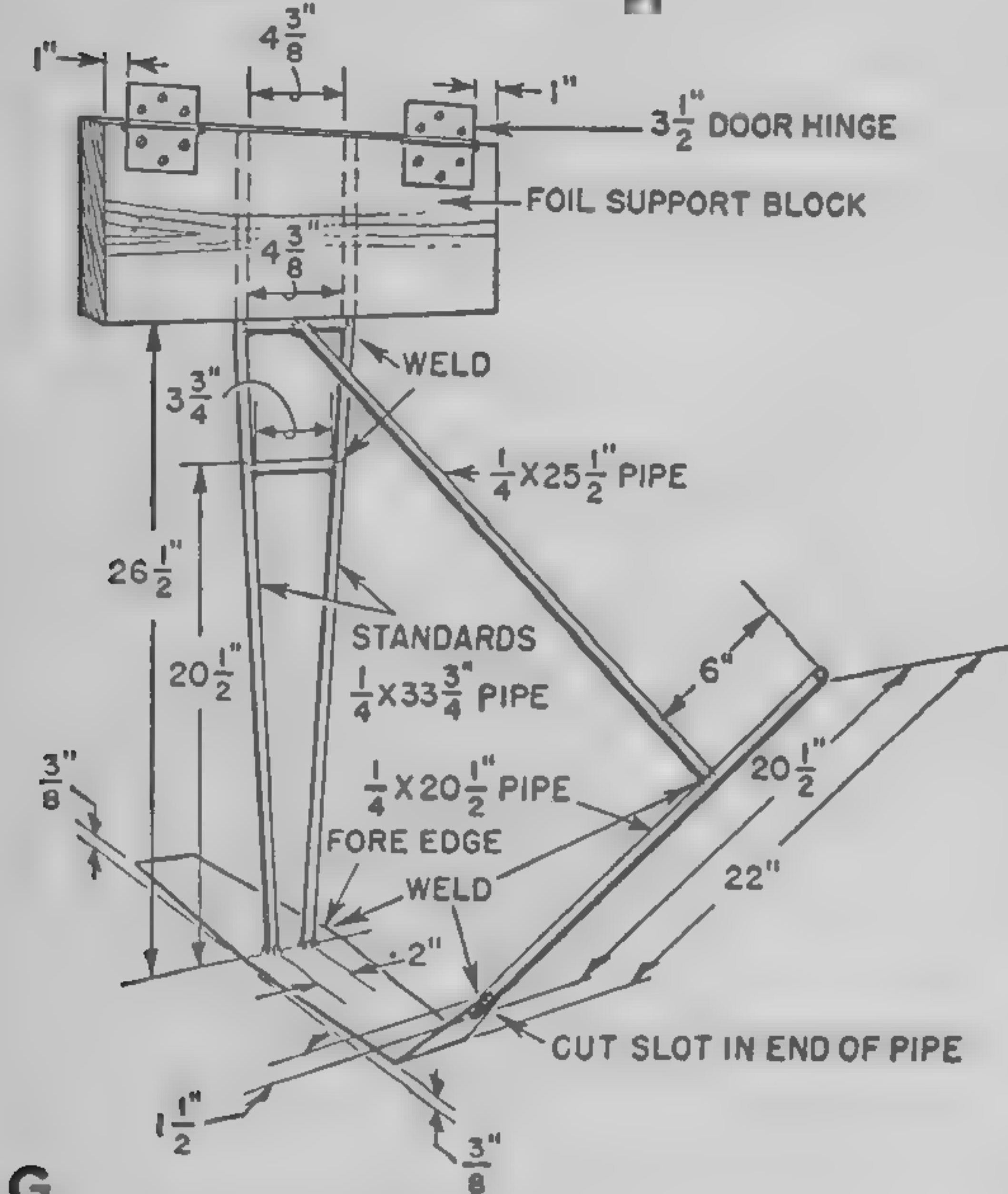
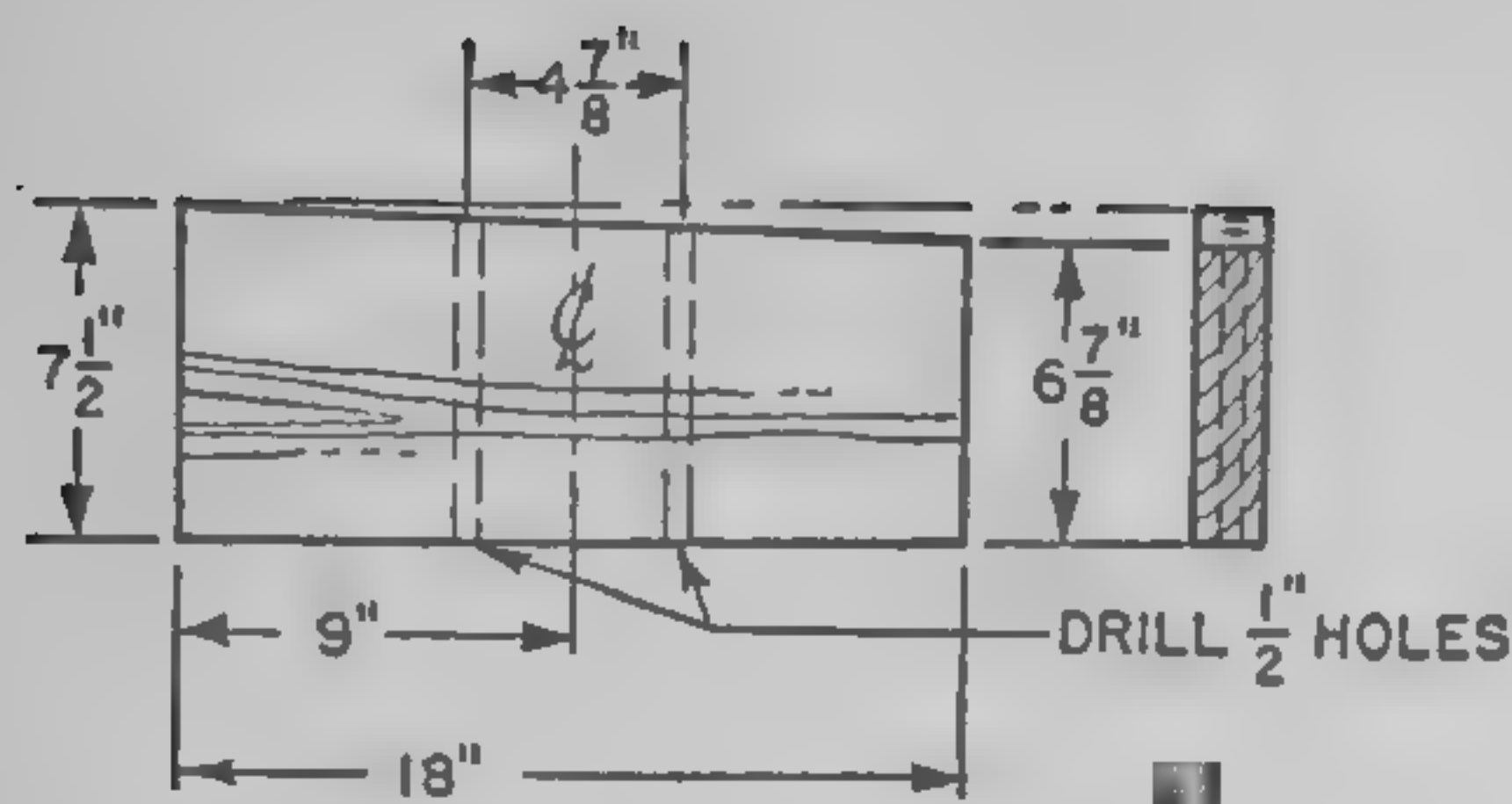
BOAT CONSTRUCTION: Wooden framework covered with sheet plywood.

you may have to alter support bracket (Fig. 1) on it for fastening directly to the projecting part as on our boat. The same will apply to any boat. Where

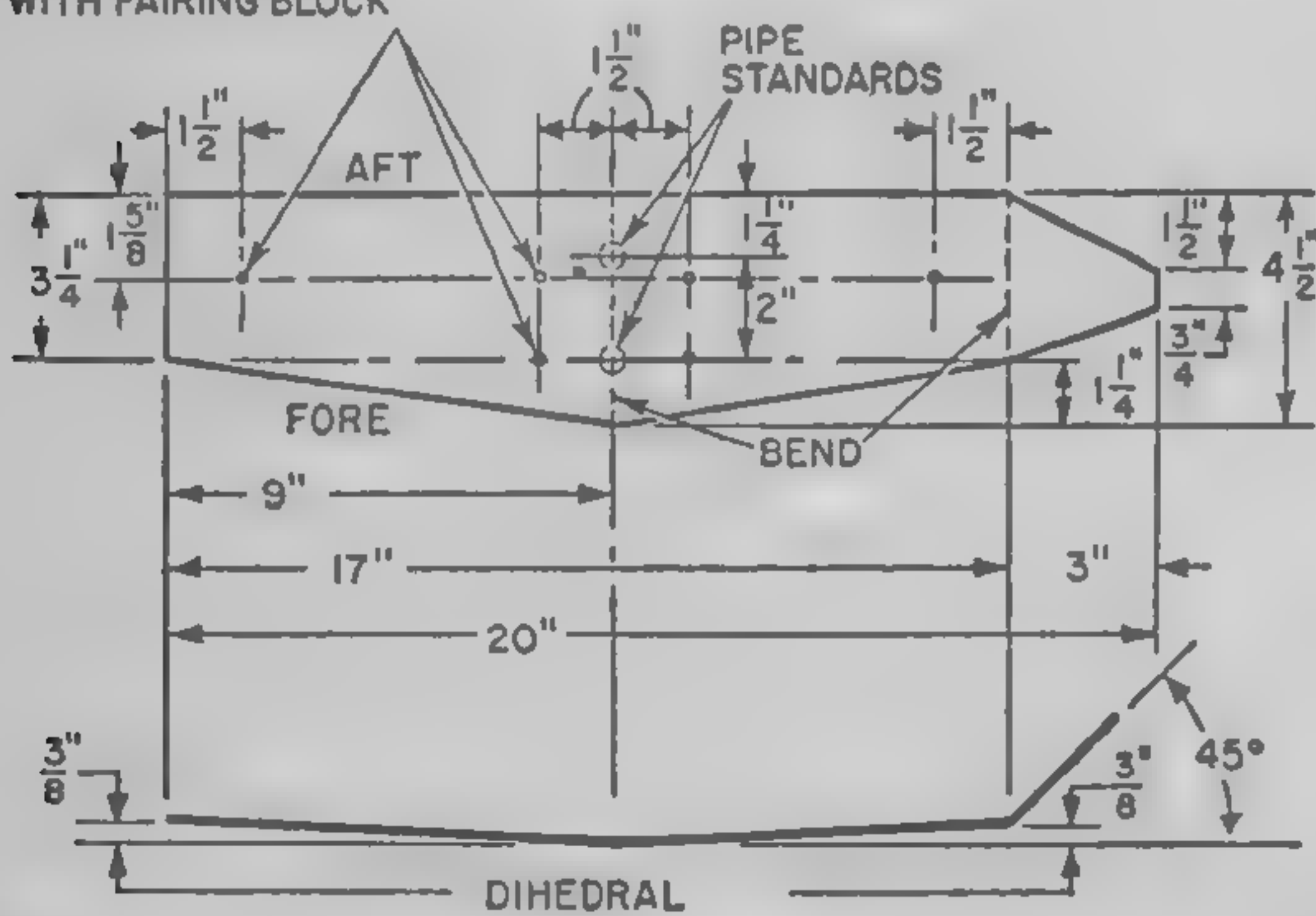


Scow-shaped bow and batted air traps on underside of boat hull aid in quickly lifting boat clear of water. Boat then rides on the three hydrofoil surfaces which are submerged 2 to 3 inches in water.





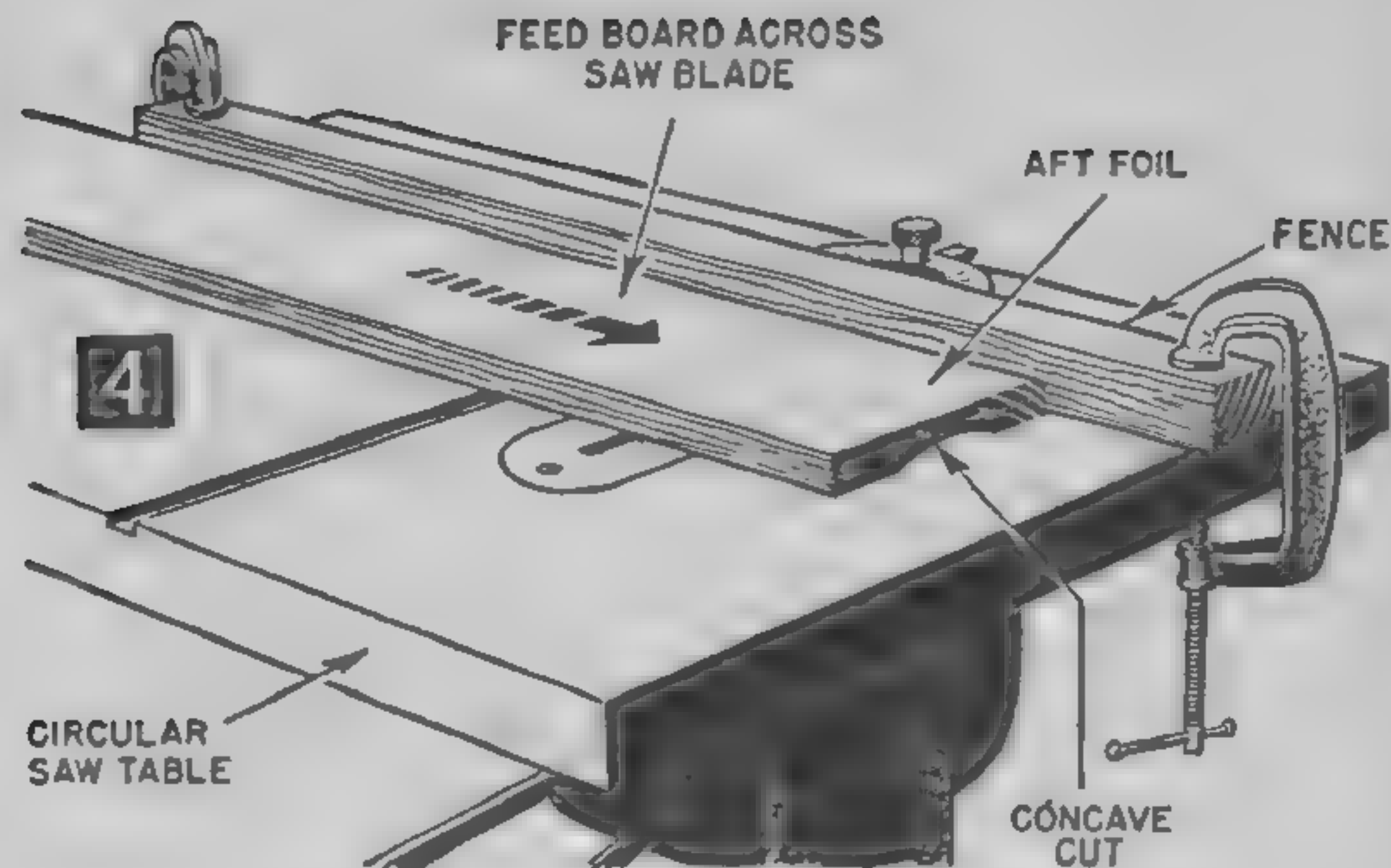
G
#7 DRILL AND 1/4-20 TAP AT ASSEMBLY
WITH FAIRING BLOCK



F
FORE BOTTOM FOIL PLATE, 2 REQ
1/8 STEEL PLATE, 1-RIGHT, 1-LEFT

there is a rounded corner indicated on the metal parts, saw off the corner diagonally with a hacksaw and grind to shape.

Make the wooden aft foil from a 3/4 x 6 x 36-in. piece of clear, straight grained fir. Since the performance of a hydrofoil in water is similar to an airplane wing in the air, its cross sectional shape must be similar. To shape the aft foil, first make a full-size drawing of the foil section on a 3 x 7-in. piece of cardboard as in Fig. 2E. Then cut the cardboard, making a template for both



upper and under foil sections.

Shape the underside of the foil first by running the piece of fir stock across your 8 or 10-in. circular saw at right angles to the blade as in Fig. 4. Make the 3/16-in. deep concave cutout in three passes across the saw blade, raising the blade 1/16 in. for each pass. Then rough out the rest of the underside with a block plane and finish to the contour of the template with coarse sandpaper. Plane the upper side of the foil to shape with a jack plane and finish to the contour of the upper template with coarse sandpaper.

Now, cut two 1 1/2-in. wide notches in the upper surface of the foil 28-in. apart, as in Fig 2D. This provides a flat surface on which to mount the two aft-foil brackets. Fasten the brackets to the foil with 1/4-in. fh bolts as in Sec. A-A Fig. 2. Then bolt the other aft-foil supports and brackets together as in Fig. 2 and set the assembly aside for mounting on the transom of your boat later.

Two forward foils, for mounting on each side of the boat, are required. These are identical in size and shape but must be made in pairs—left hand for port side and right hand as detailed in Figs. 2 and 3 for fastening to the starboard side

MATERIALS LIST—HYDROFOILS

No. Req.	Size and Description	Use
FORWARD FOILS		
2	1/8 x 4 1/2 x 20" hot rolled steel plate	bottom foil plate
22 ft	1/4" black-iron pipe	standards
1	3/4 x 5 5/8 x 12' ponderosa pine	fairing blocks
8	1/4 x 3/4" fh stove bolts	fore foils
4	3 1/2" door hinges	fore foils
1	1 5/8 x 7 5/8 x 36" fir	support blocks
2	3/8 x 6" carriage bolts	support blocks
12	#7 x 1 1/2" fh wood screw	hinges
12	10-32 x 2" fh machine screw	hinges
4	#7 x 1 1/2" rh wood screws	support blocks
1	1/16 x 6 x 60" veneer	foil-covering
AFT FOIL		
1	3/4 x 7 5/8 x 36" clear fir lumber	aft foil
2 ft	1/8 x 1 1/2 x 1 1/2" angle iron	brackets
5 ft	1/4 x 1 1/2" steel bar stock	supports
2 ft	1/8 x 1 x 1" angle iron	support bracket
8	1/4 x 1" fh stove bolts	aft foil
2	3/8 x 1" hex. head cap screws	transom bracket
2	5/16 x 1" hex head cap screws	foil bracket
4	1/4 x 3/4" hex. head cap screws	support bracket
8	1/4 x 1" fh stove bolts	foil brackets
4	1/4 x 1 1/4" hex. head cap screws	transom bracket
FIBER GLASS		
30 yds	1 1/2" wide fiber glass tape	fore foils
1 yd	38" wide fiber glass cloth	foils
1 qt	epoxy resin for above glass cloth	

5 By loosening four bolts hydrofoils up and out of the boat.

of your boat.

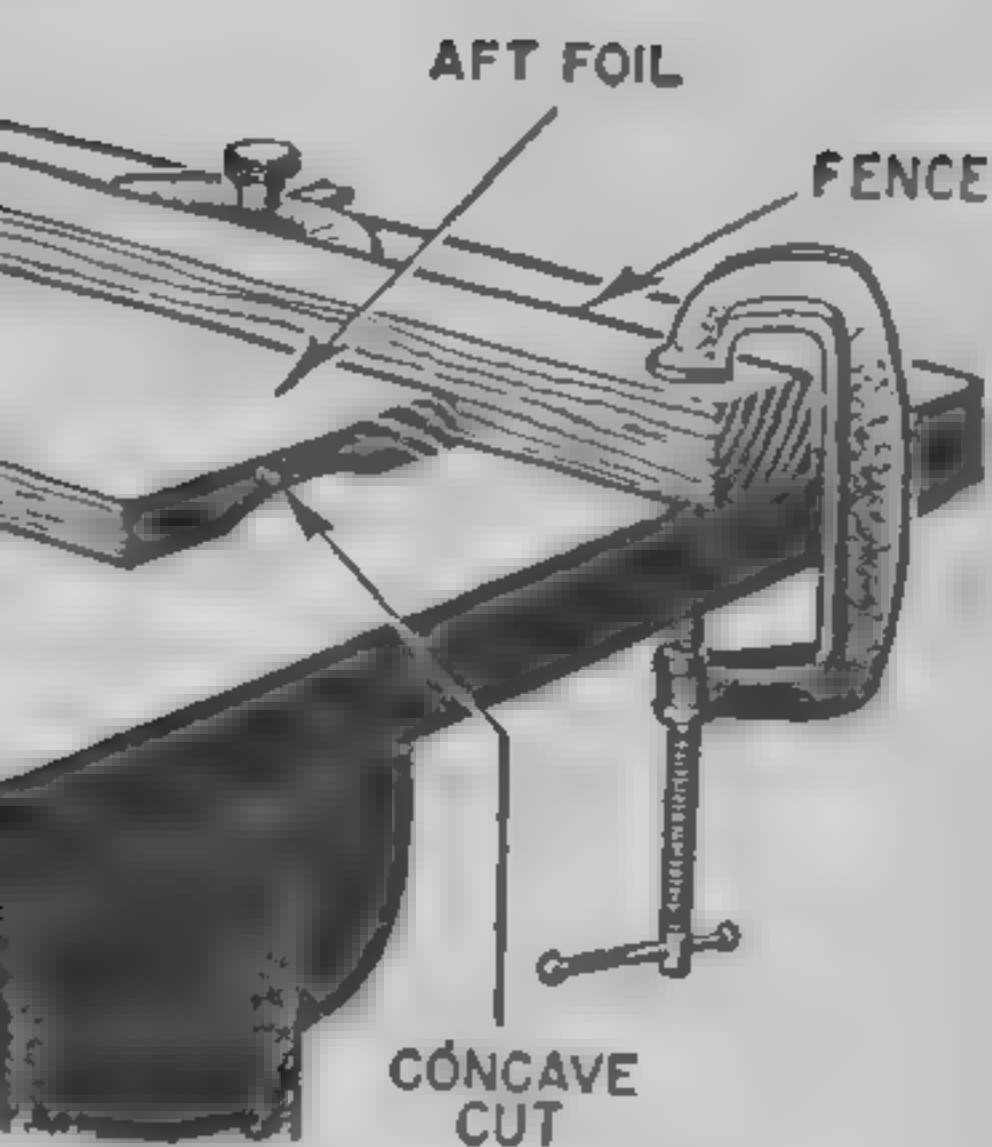
First make the fore bottom foil from 1/8-in. thick steel. Shape this material with a hacksaw while to have it cut to shape with a torch at your local welding shop. When cutting these pieces, be sure to cut the other left hand.

Make the foil standard pipe cut to lengths given in the table. Drill long slots in the ends of the pipe so they can be slid on the bottom foil plates and the joints are simply butted together.

Now make two foil support blocks. Before drilling the 1/2 in. holes, make the top ends of the forward foils so they will be parallel. The distance between the bent ends of the foil is 1/2 in. holes so the ends of the foil will be parallel. Since 1/4-in. pipe is over 1/2 in., the pipe standards are driven into the holes in the foil. Drill two 5/32 in. holes in the pipe between the foil block and drive two #7 x 1 1/2" screws into the block.

Portions of the forward foil are faired as in Fig. 2J to give the shape of the foil in the water the shape of the foil. The bottom foil is faired with the bottom foil. The thick pine blocks to the foil are faired at the center. The standards are welded. The surface of these blocks to the foil is faired. A concave cut in the shape of the fore or lead foil block will help when planing the foil to form shape. Drill and tap the bottom foil plates as in Fig. 2J. Fairing blocks with 1/4 x 1

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HYDROFOILS

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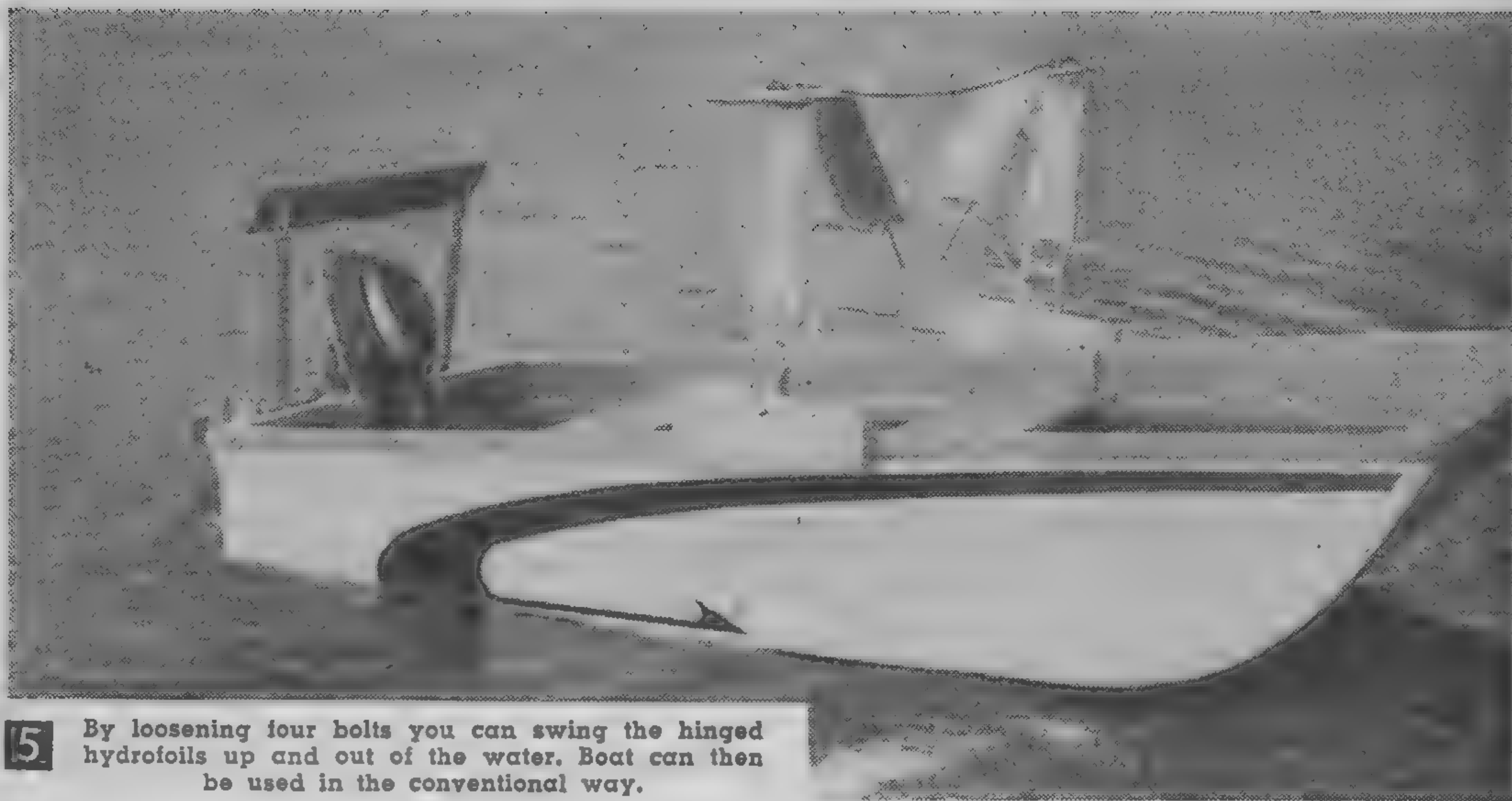
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aft foil
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foil brackets
transom bracket

fore foils
foils



of your boat.

First make the fore bottom foil plates (Fig. 3F), from $\frac{1}{8}$ -in. thick steel. Although you can saw this material with a hacksaw, it would be worthwhile to have it cut to shape on a metal shear or with a torch at your local weld shop. When bending these pieces, be sure to make one right hand and the other left hand.

Make the foil standard from $\frac{1}{4}$ -in. black-iron pipe cut to lengths given in Fig. 3G. Saw $1\frac{1}{2}$ -in. long slots in the ends of the $20\frac{1}{2}$ in. long pipes so they can be slid on the bent-up ends of the bottom foil plates and welded. All other pipe joints are simply butted together and welded.

Now make two foil support blocks as in Fig. 3H. Before drilling the $\frac{1}{2}$ in. holes in the blocks, bend the top ends of the forward foil standards slightly so they will be parallel. Then measure the distance between the bent pipes and space the $\frac{1}{2}$ in. holes so the ends of the pipes can be driven in them. Since $\frac{1}{4}$ -in. pipe has an O.D. slightly over $\frac{1}{2}$ in., the pipe standards will have to be driven into the holes in the blocks with a hammer. Drill two $\frac{5}{32}$ in. holes through the short length of pipe between the standards under the block and drive two #7 x $1\frac{1}{2}$ rh screws into the block.

Portions of the forward foils will have to be faired as in Fig. 2J to give the parts that remain in the water the shape of an airfoil section. Starting with the bottom foil plate, cut two $\frac{1}{2}$ -in. thick pine blocks to the shape of the plate, joining them at the center of the plate where the standards are welded. Plane and sand the top surface of these blocks to the contour shown in Sec. B-B, Fig. 2J. A cardboard template the shape of the fore or leading edge of the fairing block will help when planing the block to a uniform shape. Drill and tap holes in each side of the bottom foil plates as in Fig. 2F and fasten the fairing blocks with $\frac{1}{4}$ x 1 in. fh bolts.

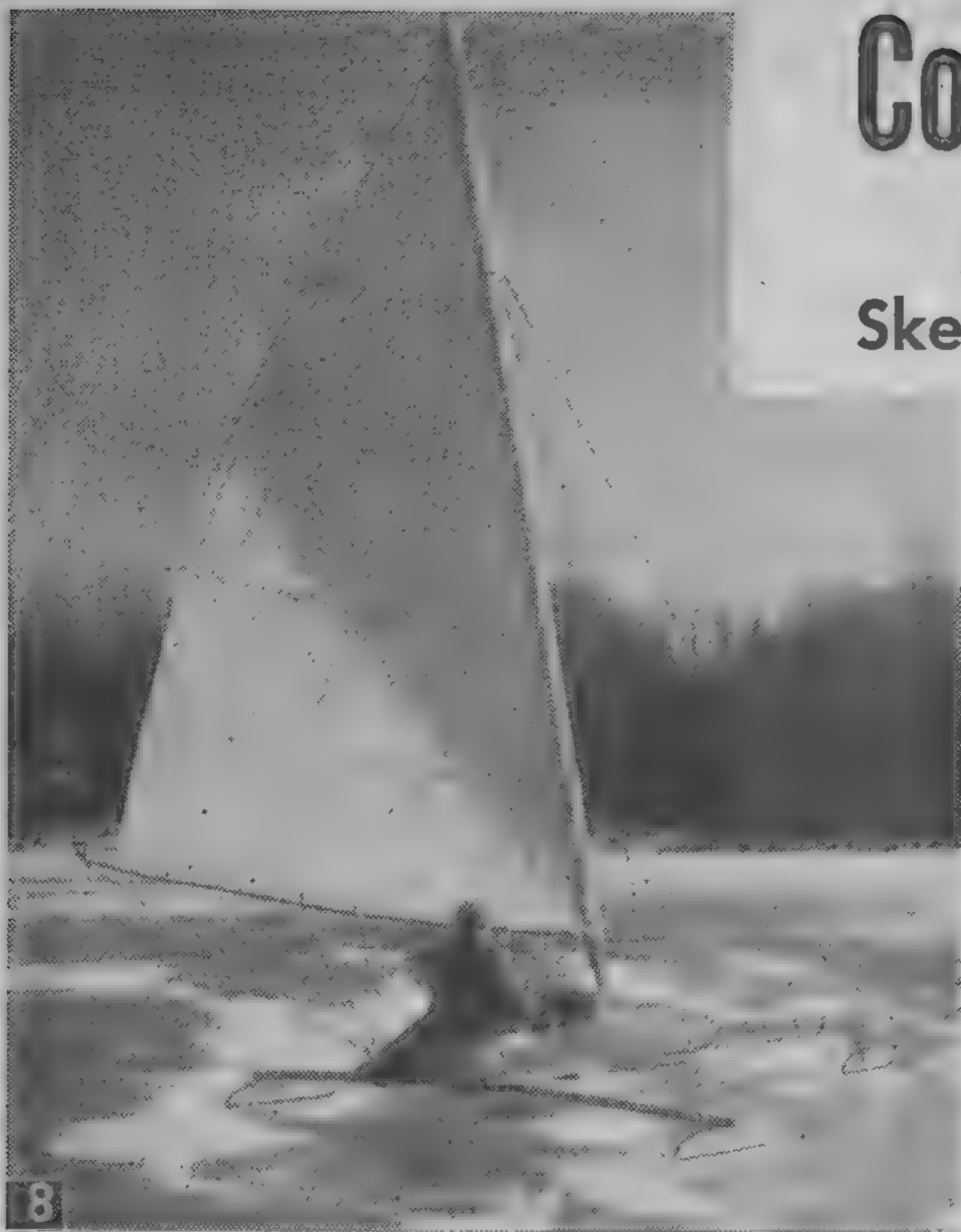
Cut off the protruding ends of the bolts and file them flush with the surface of the steel foil plates. When the foils are covered with fiber glass and resin, there will be no danger of the bolts loosening and falling out.

Fair the $20\frac{1}{2}$ -in. long pipe that is welded to the bent up end of the bottom foil plate with two fairing blocks shaped as in Sec. C-C, Fig. 2J. When fastening these blocks to the pipe, be sure to have the flat surface on the outside and the curved surface facing towards the boat. Cover both surfaces with $\frac{1}{16}$ -in. thick veneer, glued and bradded in place to keep both fairing blocks on the pipe. Then wrap it spirally with $1\frac{1}{2}$ -in. wide fiberglass tape and apply several coats of epoxy resin.

Although the two vertical pipe standards extending from the bottom foil plate to the support block do not provide any lift, they must be faired to reduce water resistance. Use three pine fairing blocks shaped as in Sec. D-D, Fig. 2J extending from the bottom plate to the lower cross pipe between the two standards. Wrap these fairing blocks with fiber glass tape and coat with epoxy resin. Also cover the bottom foil with fiberglass cloth and resin. Use strips of fiberglass cloth to build up a streamlined fillet where the standards join the bottom foil plate. Give the fore and aft hydrofoils two coats of marine enamel to complete them.

Our next issue (on sale March 1, 1960) will include plans for building the boat on which these hydrofoils were tested.

● Craft Prints in enlarged size for building hydrofoil boats are available at \$1.50 each. Order by print number. To avoid possible loss of coin or currency in the mails, we suggest you remit by check or money order. (No. C.O.D.'s or stamps.) Now available, our new illustrated catalog of "196 Do It Yourself Plans," 10¢. SCIENCE AND MECHANICS, 450 East Ohio Street, Chicago 11, Illinois. Please allow three to four weeks for delivery.



Highest speed is obtained by quartering the wind with the boom held down tight and inboard to keep the sail flat. Tacking, as shown above, is handled as with a sail boat.

AFTER building and fairing the fuselage framework as described in Part 1 of this article (S&M Dec. '59) your next step is the application of the plywood covering on the framework.

Lay out the fore and aft cover pieces on a 4x8 ft. sheet of 1/8-in. plywood as in Fig. 9 and saw the pieces to shape. Install the two aft pieces first. Plane the edges that will meet over the deck batten for a neat tight seam and apply glue to both contacting frame members and plywood. Fasten with #12x1 1/4-in. *Stronghold* nails or #7x1 in. *fh* screws spaced 3 in. apart along chines and 4 in. apart to fasten the frames.

Before installing the fore pieces, soften the fore ends of the plywood by sopping with water and ironing to drive steam into the wood. When the plywood is quite flexible, apply glue and install on each side of the fuselage framework. Fasten with nails or screws as you did the aft pieces. The aft end of the fore pieces lap over the aft pieces. Plane the edges of the plywood flush along the floor boards and sand the edges around the cockpit.

Make the deck pad that serves as the mast socket from two pieces glued together as in Fig. 10. Before drilling the

Cold Lightning

A 100 *mph*-plus Skeeter Class Ice Boat

By WILLIAM D. JACKSON

Craft Print Project No. 302

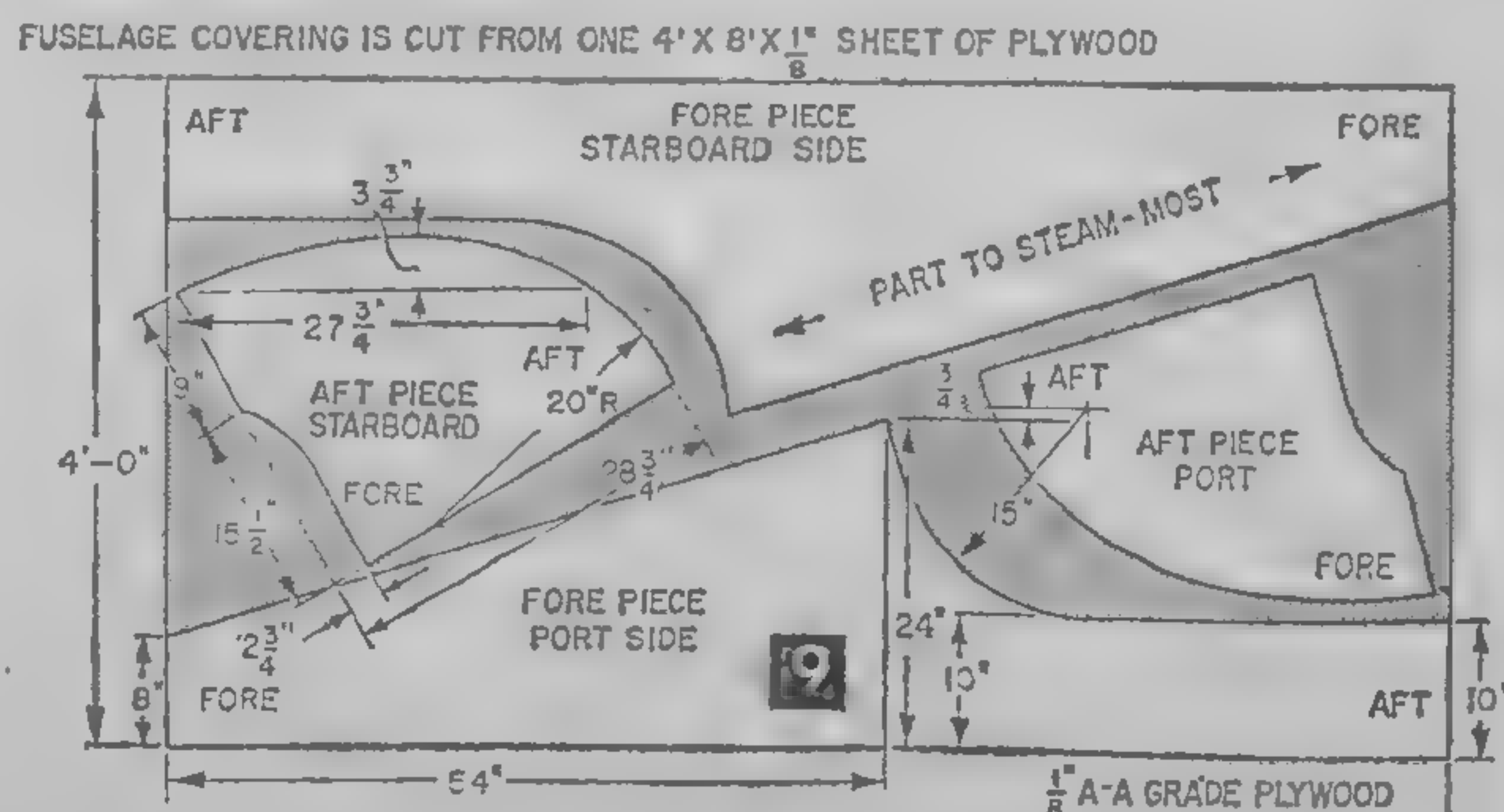
Part 2

1 1/8-in. hole, mount it on the fuselage directly over the #1 frame and deck longeron with glue and one #10 x 2 1/2-in. *fh* screw forward and one #8 x 1 1/4-in. *fh* screw aft. Force a mixture of glue and sawdust under the pad at the sides where there is an opening due to curvature of the fuselage covering. Now drill the 1 1/8 in. hole through the pad and into the deck longeron to a total depth of 2 in. for the mast-step plug.

Running Gear. The runner beam is made of three pieces of $\frac{3}{4}$ -in. lumber with ends tapered as in Fig. 11. Make the center support (Fig. 11) from two 10-in. lengths of 2 x 4-in. stock and place it on the floor of your basement or garage. The runner beam is to be bowed over this center support and the ends of the beam held down against the floor

with two 2x4's propped up against the ceiling rafters. Have this bending rig all set up before applying glue to the contacting surfaces of the running-beam boards so that you can work quickly before the glue sets up. Have someone help you spread the glue and handle one of the 2 x 4-in. props.

Allow the glue to dry at least three days while in the bent position so that the glue reaches full strength. Ice boats are notoriously rough riders and this beam is your main spring and takes considerable punishment. Finish the beam by planing the edges round and sand smoothly. Apply three coats of spar varnish. Next, make up



two runner struts from 2 x 11. Fasten these to the underside with one #12 x 2½-in. fh screw.

While the fuselage is turned, place the runner beam across the fuselage and center it at the center of the fuselage. Fasten the runner beam to the fuselage with $\frac{5}{16}$ x 5-in. lag screw driven through the fuselage. Then, after checking to see that the runner beam is at right angles to the fuselage, drill $\frac{3}{8}$ in. holes through the fuselage at the runner struts and chines as shown in Fig. 11.

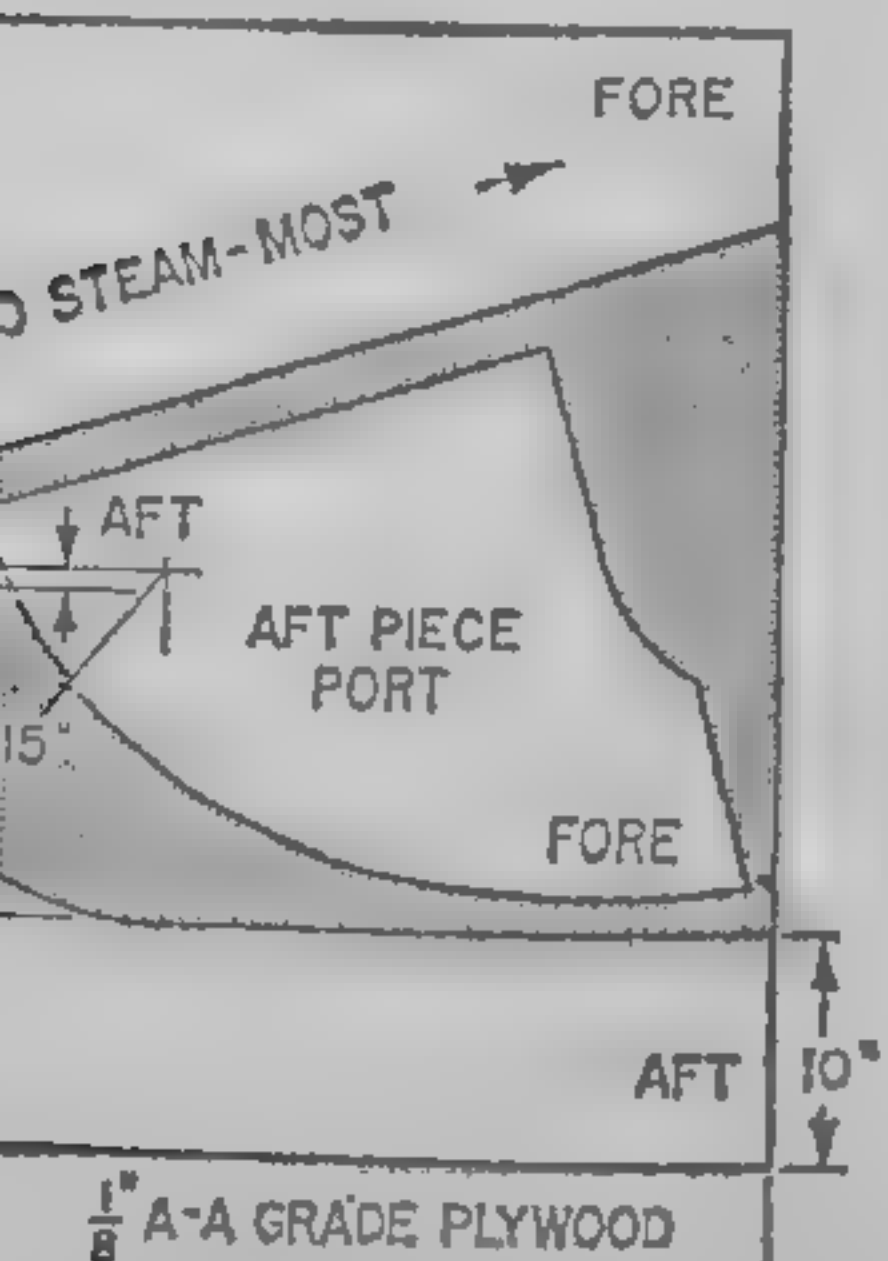
Three runners are used: two stationary runners on the beam and one steering runner on the main longeron. Motion of the beam is controlled (Figs. 12A and B) from 1

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two runner struts from 2 x 4-in. stock as in Fig. 11. Fasten these to the underside of the fuselage with one #12 x 2 1/2-in. fh screw at each end.

While the fuselage is turned bottom-side-up, place the runner beam across the runner struts and center it at the center of the main longeron. Fasten the runner beam at the center with a 5/16 x 5-in. lag screw driven into the main longeron. Then, after checking to see that the runner beam is at right angles to the center of the fuselage, drill 3/8 in. holes through runner beam, runner struts and chines for 5/16 x 7 in. bolts as in Fig. 11.

Three runners are used on this ice boat: two stationary runners on the ends of the runner beam and one steering runner at the forward end of the main longeron. Make all the runners (Figs. 12A and B) from 1 1/4-in. thick hardwood.

Bevel the bottom edges to take 1 in. angle-iron blades. Have your local weld shop cut the fore ends of the angle-iron blades with a torch as in Fig. 12C and bend and weld the cut ends together to make rounded leading edges. Also grind the front and rear ends of the sharp angle iron corners round as in Fig. 12D. Fasten blades to runners with #7 x 1-in. fh screws.

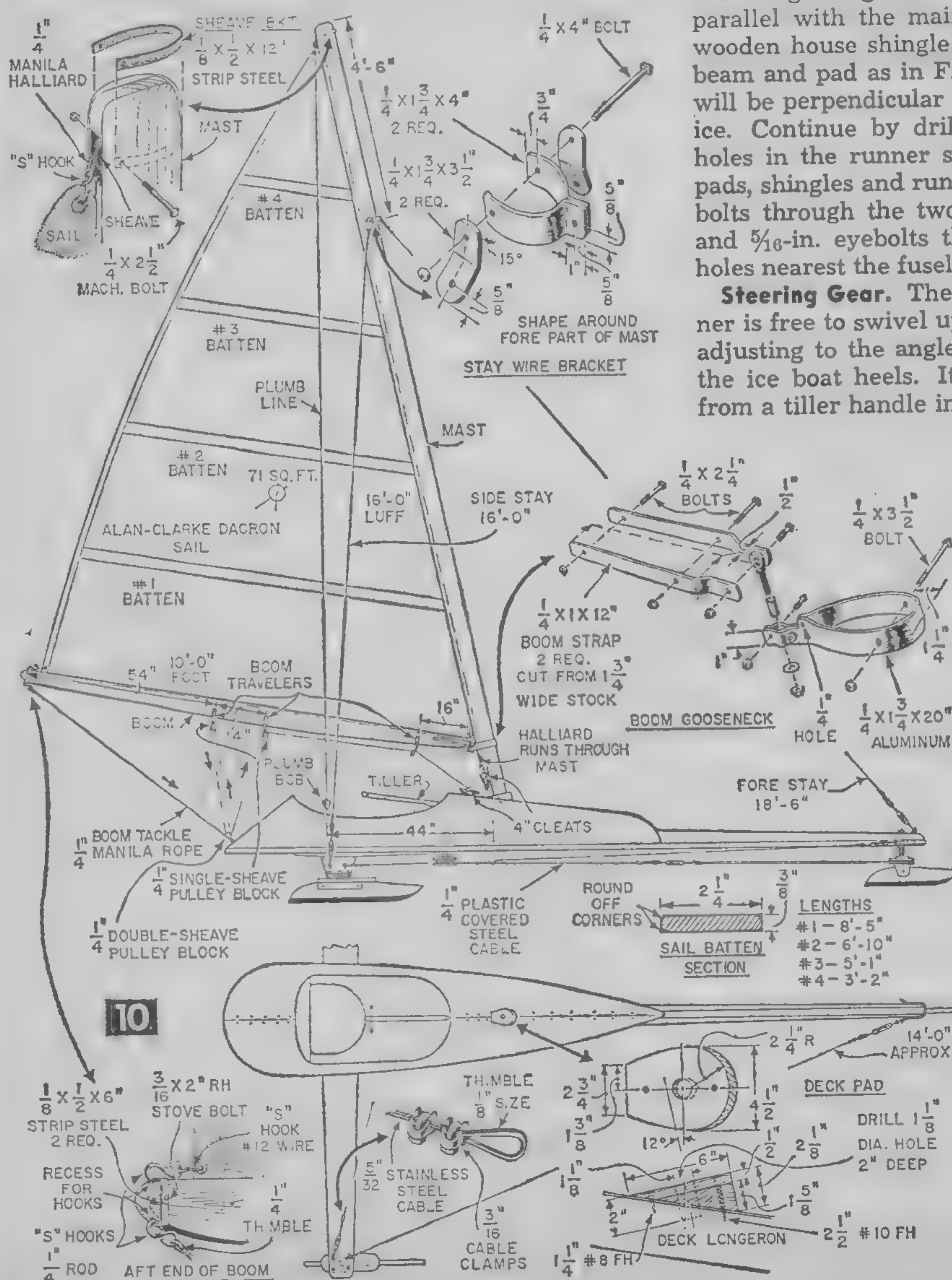
To fasten the aft or stationary runners to the runner beam, make up two pads and two pairs of runner supports from 2-in. angle iron as in Fig. 12E. Fasten the pads to the top edges of the aft runners with two #8 x 1 3/4 fh screws and bolt the angle-iron supports under the pads on each side of the runners. Then, while the fuselage is still upside down, locate the assembled runners 2 in. from the ends of the runner beam and clamp in place. Check to make sure the edge of the blades

are at right angles to the runner beam and parallel with the main longeron. Place a wooden house shingle between the runner beam and pad as in Fig. 12F so the blades will be perpendicular to the surface of the ice. Continue by drilling the four 5/16-in. holes in the runner supports through the pads, shingles and runner beam. Use 1/4-in. bolts through the two sets of outer holes and 5/16-in. eyebolts through the inner or holes nearest the fuselage.

Steering Gear. The fore or steering runner is free to swivel up or down, to be self-adjusting to the angle of inclination when the ice boat heels. It is steered by cable from a tiller handle in the fuselage cockpit

(Fig. 10). For the runner spindle (Fig. 12G), cut the head off a 5/8 x 8-in. bolt and thread the cut end with a 3/8 in. pipe die. Place a 3/8 to 1/2-in. reducing bushing and a 1/2-in. pipe floor flange on the pipe-threaded end of the bolt and braze or weld the parts together so they will not loosen. Make the steering-runner fork as in Fig. 12H and two of the steering drums (Fig. 12J).

When assembling the steering-runner parts, center the floor flange on the spindle on one of the steering drums and, using two opposite holes in the flange as a



guide, drill two $\frac{9}{32}$ -in. holes through the drum. Use this same hole spacing to drill the $\frac{9}{32}$ -in. holes in the fork. Then bolt the fork and drum to the flange on the spindle with $\frac{1}{4}$ x 2-in. bolts as in Fig. 12K. Bolt the steering runner between the fork sides.

To mount the steering-runner on the fuselage, bore a $\frac{3}{4}$ -in. hole 6 in. from the fore end of the longeron as in Fig. 12K and counterbore the ends of the hole $\frac{7}{8}$ in. so that you can screw two $\frac{1}{2}$ x $\frac{3}{4}$ -in. pipe bushings into the hole. The outside threads on the bushings will cut into the wood and keep the bushings in place. Then slide a $\frac{5}{8}$ -in. washer and a valve spring from an International Harvester truck, or similar truck engine, on the runner spindle. Place another washer on top of the spring and slide the spindle through the hole in the longeron. Fasten with a $\frac{5}{8}$ -in. nut on the spindle.

Now, drill another hole through the longeron 63 in. from the aft end as in Fig. 5, Part 1 for the tiller-handle spindle. Accurately lay out the location of this hole on the top and bottom of the longeron pieces and drill the 1¼-in. counterbores as in Fig. 12L first. Then drill a through hole with a 7/8-in. drill bit from each side so that the counterbores will be concentric with the 7/8-in. hole. Screw ¾ x 1-in. pipe bushings in the counterbores to act as bearings for the tiller-handle shaft.

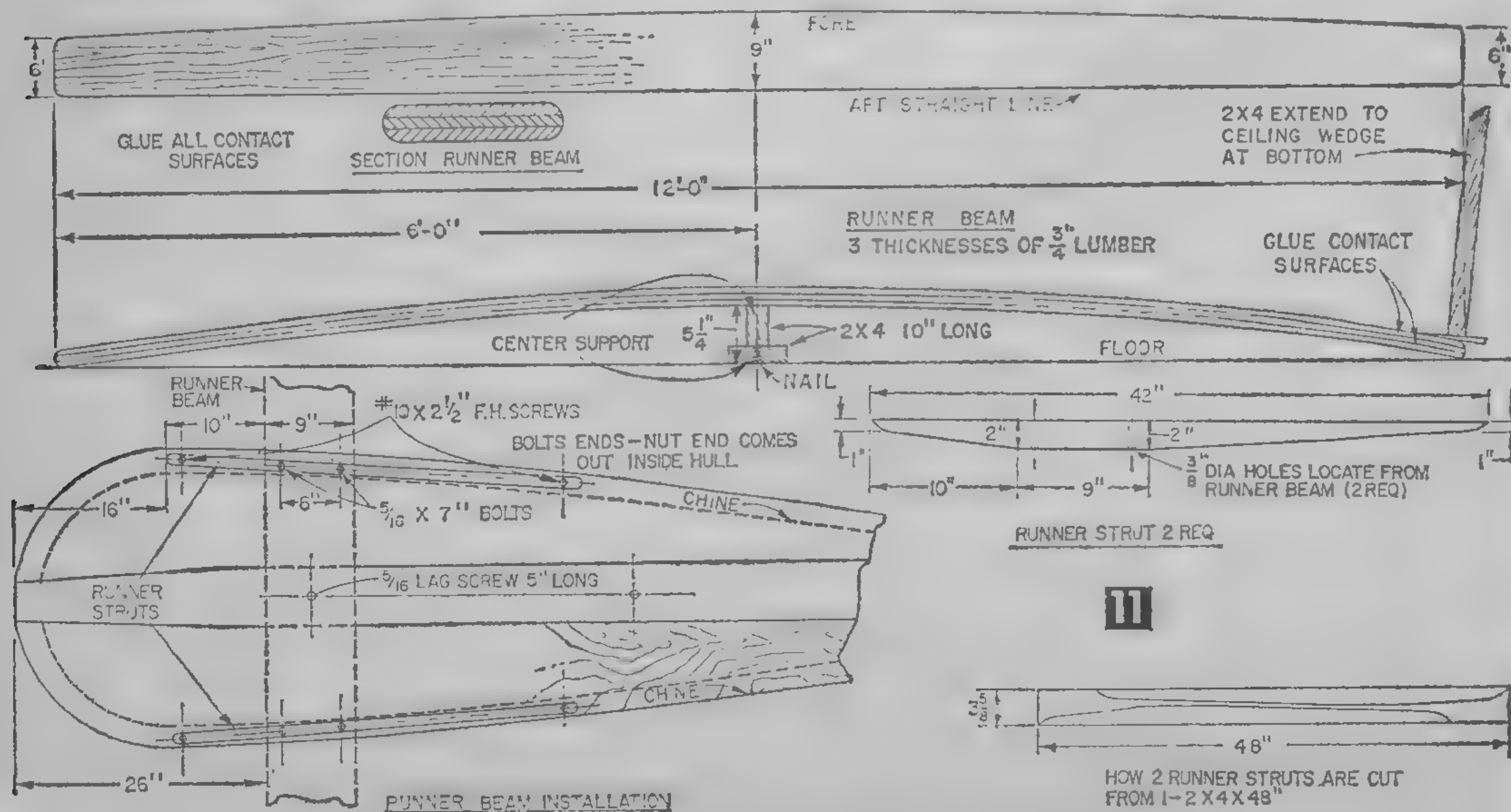
The handle shaft is a 10 $\frac{3}{4}$ -in. length of $\frac{1}{2}$ -in. pipe screwed into a $\frac{1}{2}$ -in. pipe floor flange and tack welded so it will not turn loose. Bolt the steering drum to the pipe flange and slide the assembly up through the hole in the longeron from the bottom of the fuselage. Place a few blocks on the floor under the drum to keep the steering shaft in place.

Make the tiller handle and tiller-handle bracket (Figs. 12M and N), and slide the bracket over the end of the tiller shaft projecting above the longeron. Using the two $\frac{3}{32}$ -in. holes in bracket

MATERIALS LIST—ICE BOAT

Amt. Req.	Size and Description	Use
ALUMINUM AND IRON		
1	1/4 x 1 3/4 x 60" soft aluminum bar stock	rigging fittings
1	8 x 10" roof-flashing sheet aluminum	mast
1	1/8 x 4 x 8 1/2" steel plate	fork
1	1/8 x 1/2 x 30" hot-rolled strip steel	mast and boom
1	1/4 x 1 1/2 x 4" steel bar stock	steering handle
1	1/8 x 1 x 18" hot-rolled strip steel	fore stay fitting
1	1/8 x 1 x 1" x 9' angle iron	runners
1	1/8 x 2 x 2" x 4' angle iron	aft runners
1	60 lb. test valve spring from International Truck Engine	
PIPE FITTINGS		
2	1/2-3/4" reducing bushings	steering gear
2	3/4-1" reducing bushings	steering gear
1	3/8-1/2" reducing bushings	steering gear
2	1/2" pipe floor flanges	steering gear
2	1/4 x 2 1/2" long pipe	steering gear
1	1/2 x 10 3/4" long pipe	steering gear
1	1 x 5 1/2" long pipe	steering gear
1	1" pipe cap	steering gear
RIGGING HARDWARE		
90 ft	5/32" stainless steel 1 x 19 strand rigging wire	
80 ft	1/4" manila rope	
3	1/4" single-sheave, fast eye pulley blocks	
1	1/4" double-sheave, fast eye pulley block	
24 ft	1/4" plastic covered, flexible steel outboard steering cable	
8	1/8" wire-rope thimbles	
4	1/4" wire-rope thimbles	
24	3/16" cable clamps	
1	4" awning mast-cleat	
5 ft	#12 cold drawn, steel wire or 3/16 gas-welding rods	
1 ft	1/4" steel rod	
6	1/4" turnbuckles (hook and eye type)	
3	1/4 x 1" machine bolts	
2	1/4 x 2 1/4" machine bolts	
1	1/4 x 2 1/2" machine bolt	
2	1/4 x 3 1/2" machine bolts	
1	1/4 x 4" machine bolt	
(Following items available from Alan-Clarke Co., 75 Chambers Street, New York 7, N. Y.)		
1	Sail, made especially for this ice boat	
3	#1 Boom travelers Cat. #6390	
1	1 3/4 x 7 1/16" mast head sheave Cat. #8464	
1	1/4 x 2" shoulder eye bolt Cat. #2221	

as guides, drill two $\frac{9}{32}$ -in. holes through the tiller shaft and fasten bracket to shaft with two $\frac{1}{4}$ x $1\frac{1}{2}$ -in. bolts as in Fig. 12L. Bolt the tiller handle to the bracket with a $\frac{3}{8}$ x 2-in. bolt.



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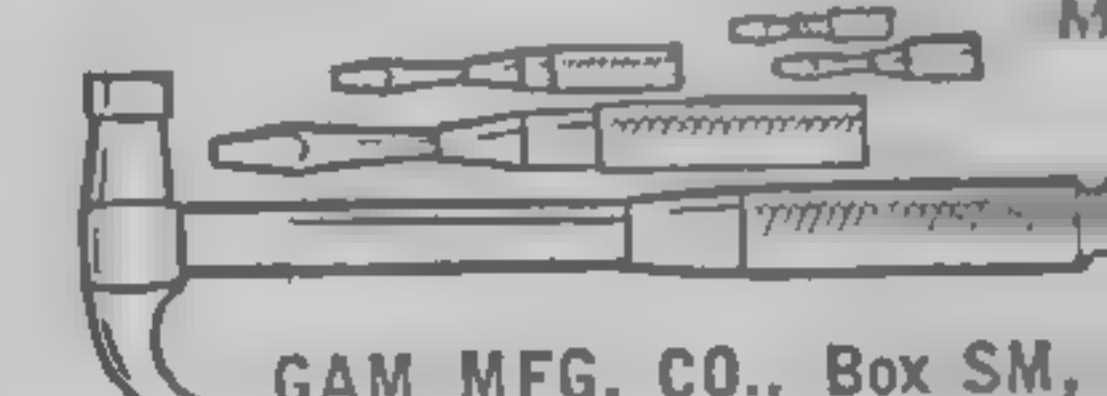
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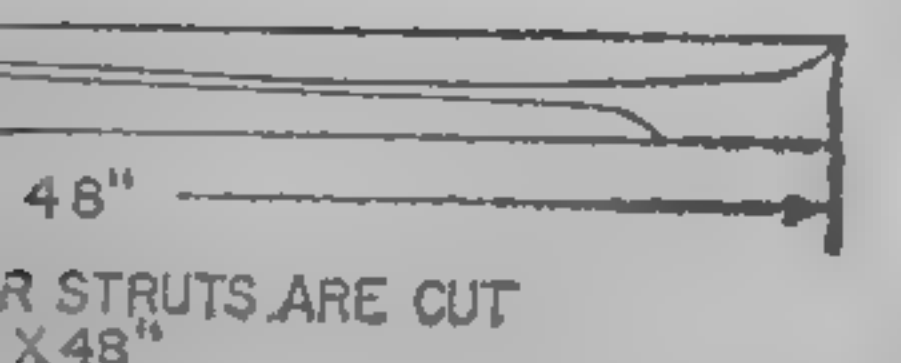
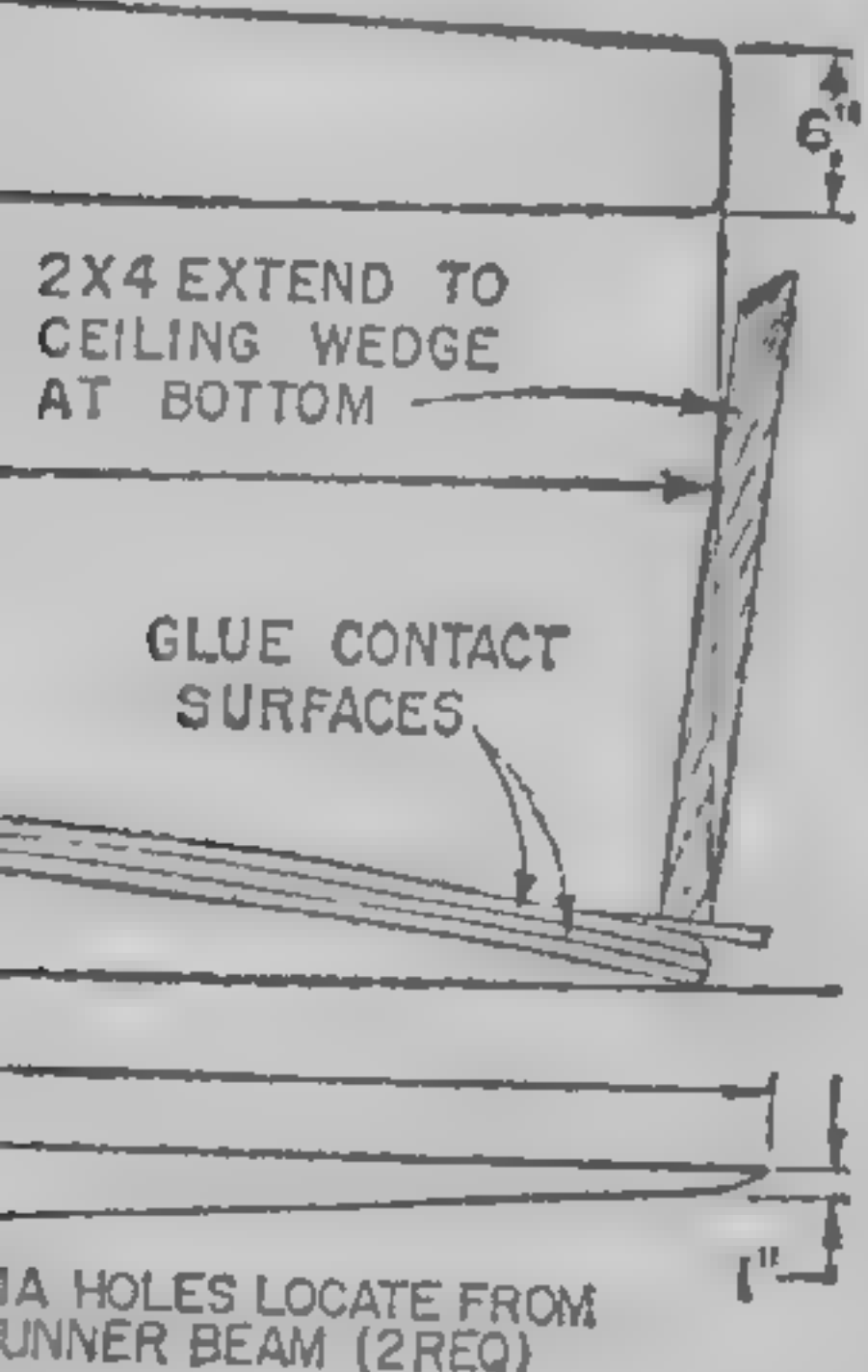
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DWARE
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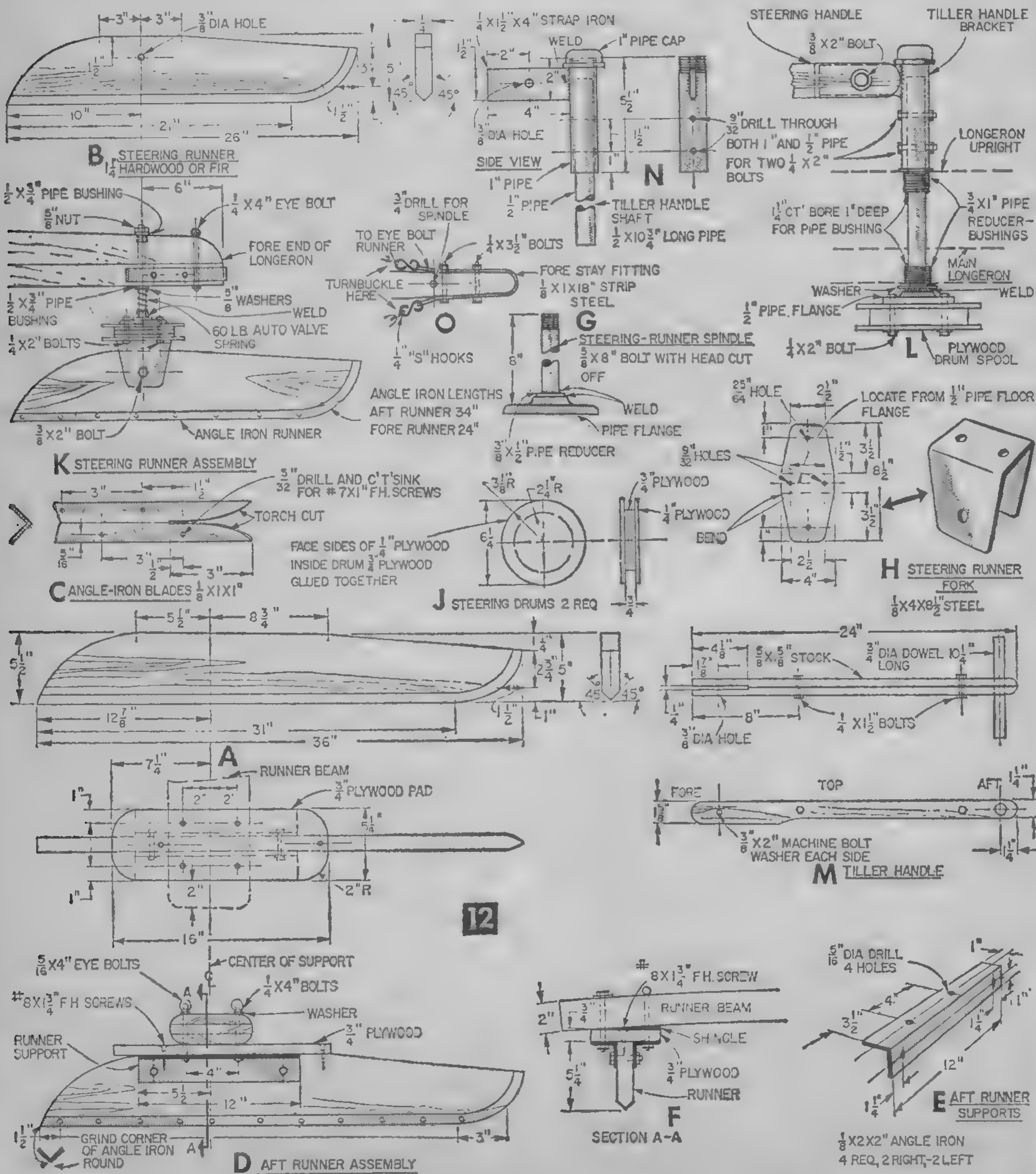
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The drum on the tiller shaft is connected to the drum on the steering runner with a cable. Use 24 ft. of $\frac{1}{4}$ -in. dia., plastic-covered, flexible cable—the same type used for steering outboard motors. Wrap the cable one complete turn around the drums and connect the two ends of the cable midway between the drums with a turnbuckle.

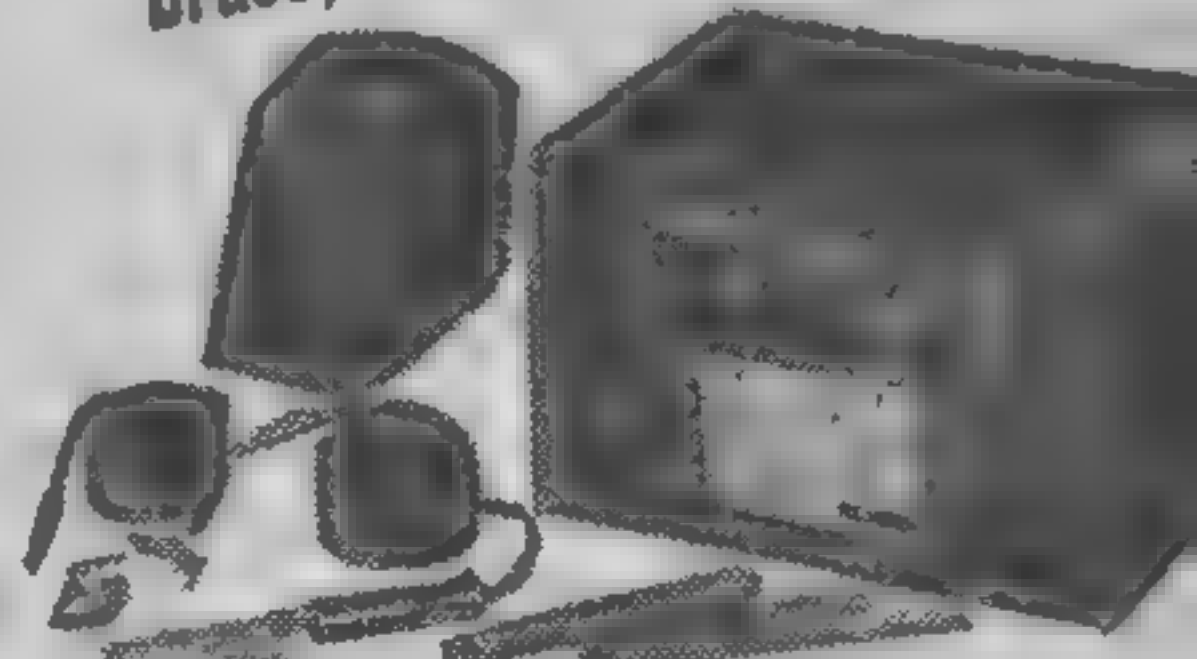
Mast and Boom. Starting with the mast, first rip the 18-ft. length of $\frac{3}{4} \times 9\frac{5}{8}$ -in. board lengthwise to make two $4\frac{3}{4}$ -in. wide pieces for the mast sides (Fig. 13C). Rip a $1\frac{1}{4}$ -in. strip from one of the 18-ft. lengths of $\frac{3}{4} \times 3\frac{5}{8}$ -in. boards for the filler piece. The $2\frac{1}{4}$ -in. strip left is for the fore piece. Ignoring the note "plane to $\frac{5}{8}$ in. thick" on the materials list, rip the remaining 18-ft.

length of $\frac{3}{4} \times 3\frac{5}{8}$ -in. lumber into two equal width strips of $1\frac{1}{4}$ in. each. Then, turning these strips on edge, again rip them to obtain a $1\frac{3}{32}$ -in. thick strip from each one for the sail track pieces. Check the thickness of the $\frac{3}{4}$ -in. filler strip before ripping these strips. Often so-called 1-in. stock measures $\frac{13}{16}$ in. in thickness, and the two sail track pieces must equal the thickness of the filler when glued together. Before gluing, however, cut a $\frac{7}{16} \times \frac{7}{32}$ -in. deep groove in each sail track piece $\frac{3}{16}$ in. from the edge as in Fig. 13C. Note in Fig. 13A that the sail track pieces are 15 ft. 10 in. long, the filler 16 ft. $1\frac{1}{2}$ in. long, while the dimensions for the mast sides and fore pieces are actually 18 ft. long.



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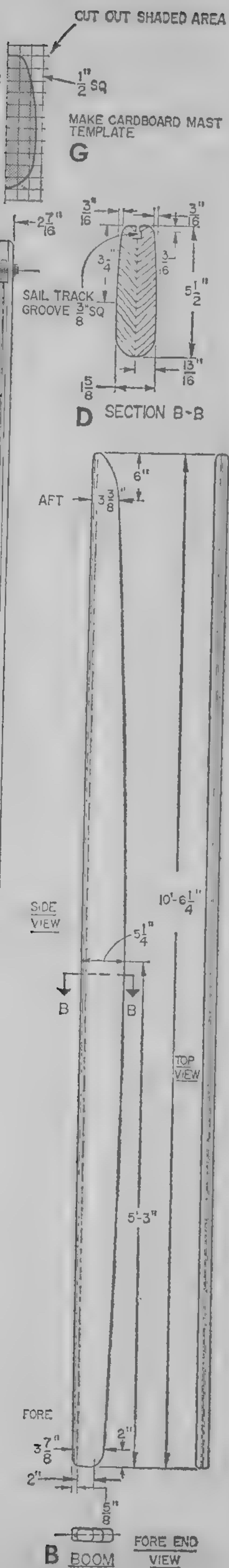
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side with glue and clamp the assembly together with all the clamps you have available. Glue the fore piece to the edges of the mast side and secure with bar clamps.

Unless you are a professional boat builder, you probably will not have enough C-clamps to apply pressure uniformly along the entire length of the mast. A good substitute for clamps is several long strips of inner tube tightly wrapped around the mast 4 or 5 turns. Space these inner-tube "clamps" about 6 in. apart. The bolt clamps shown in Fig. 13F are another inexpensive way of clamping the mast until the glue dries.

Allow the mast to dry 3 or 4 days in a heated garage or basement before removing the clamps. Then place the mast on saw horses and mark center-lines lengthwise on the fore piece end sail track piece. Lay out and cut a cardboard template as in Fig. 13G and start planing the mast to shape. Use the template to check the amount of stock removed. Shape the top and bottom of the mast as in Fig. 13A. Final smoothing is best done with a portable electric belt sander.

Use a portable electric saw with the blade set at $\frac{5}{16}$ -in. depth of cut to make the saw cut into the sail-track groove (Fig. 13C). Sand the saw cut corners round by inserting coarse sand paper folded several times into the cut. To feed the sail into the slot, chisel open the groove to full width for a distance of 6 in. at the bottom of the mast as in Fig. 13A. Apply three coats of spar varnish on the mast, sanding lightly between the first two coats. When thoroughly dry, force paste wax in the sail track groove with a putty knife and polish with a rag folded and run into the groove. Drill a 1" hole 6 in. deep in the bottom of the mast and drive in a 1 x 8-in. hardwood dowel for the mast step as in Fig. 13H. To protect the bottom of the mast, wrap it with sheet aluminum and fasten with $\frac{3}{4}$ -in. aluminum nails.

The boom (Fig. 13B) is fairly simple to make as compared to the mast, since only two pieces are glued together. Cut the sail-track groove (Fig. 13D) as you did for the mast and glue the two boom sides together following the procedure used for making the mast. Plane and sand the boom to shape, and give it three coats of varnish.

Rigging. Since most of the rigging hardware required is of a special shape and size, commercially made sailboat hardware cannot be used. Starting at the top of the mast, bend a 12-in. length of $\frac{1}{8}$ x $\frac{1}{2}$ -in. strip steel around it as in Fig. 10 for the sheave bracket. Fasten in place with a C-clamp and drill a $\frac{9}{32}$ -in. hole through bracket and mast for the sheave. Before installing the sheave, draw a 36-ft. length of the $\frac{1}{4}$ -in. manila rope through the mast with an 18-ft. length of wire. Then install the sheave with a $\frac{1}{4}$ -in. bolt through bracket and mast.

Going to the aft end of the boom, bend two pieces of $\frac{1}{8}$ -in. strip steel around the boom and fasten with a $\frac{3}{16}$ -in. stove bolt. Bend two S-shaped hooks from $\frac{1}{4}$ -in. rod and insert them under the steel bands. Boom travelers, and

pulley blocks on the boom (Fig. 10) are purchased parts. Bolt the travelers to the boom and make up S-hooks from #12 wire to fasten the pulley blocks to the travelers.

The boom goose neck and stay wire bracket on the mast are hand made from $\frac{1}{4}$ x $1\frac{3}{4}$ -in. aluminum bar stock. The soft aluminum is quite ductile and bends easily, and can be cut with a wood cutting band.

Bend an 18-in. length of $\frac{1}{8}$ x 1-in. strip steel around the fore end of the longeron and fasten with two bolts as in Fig. 12-O. Drill $\frac{9}{32}$ -in. holes in the two tang ends for the hook end of the turnbuckles, then run $\frac{5}{32}$ -in. stainless steel cables from the turnbuckles to the eyebolts on the ends of the runner beams. The mast is held upright with the three stay wires as in Fig. 10. Use 20 $\frac{1}{2}$ ft. of $\frac{5}{32}$ -in. stainless stranded cable for the fore stay and fasten it to the stay-wire bracket on the mast with a $\frac{1}{8}$ -in. thimble and two $\frac{3}{16}$ -in. cable clamps. Similarly fasten two 18-ft. long cables to the bracket for the side stays. (These lengths of cable include 2 extra feet for fastening).

Now, with a plumb bob hanging from the top of the mast as in Fig. 10, have a helper hold the mast upright in the fuselage. Tilt the mast until the distance from plumb bob to bottom of mast is 44 in. and quickly fasten the stays to their turnbuckles. A more accurate adjustment of the mast can be made later by adjusting the turnbuckles. Sails made especially for this ice boat design are available from Alan-Clark Co.—see Materials List for address.

Make up the four sail battens to size and length given in Fig. 10 and slide them into the batten pockets sewn on the sails.

Fasten the top of the sail with an S-hook through the grommet to the halliard. Then feed the luff edge of the sail into the sail-track groove in the mast through the opening near the bottom of the mast and haul it up with the halliard. Feed the foot of the sail into the sail-track groove in the boom and fasten it at the aft end of the boom with an S-hook as in Fig. 10. Starting at the aft end of the boom, rig the $\frac{1}{4}$ -in. manila boom tackle through the pulley blocks.

Sailing an ice boat is nothing like sailing a sail boat. It's true that "tacking" is similar, but to achieve speeds of two to three times the speed of the wind, an ice boat's sails must be kept stiff and not allowed to billow—so haul the boom down tight to keep it inboard and run quartering the wind. Running with the wind will give you the slowest speed. To come about, head into the wind and throw the tiller over to one side.

That sums up the construction and instruction. Good luck and happy, speedy ice boating to you.

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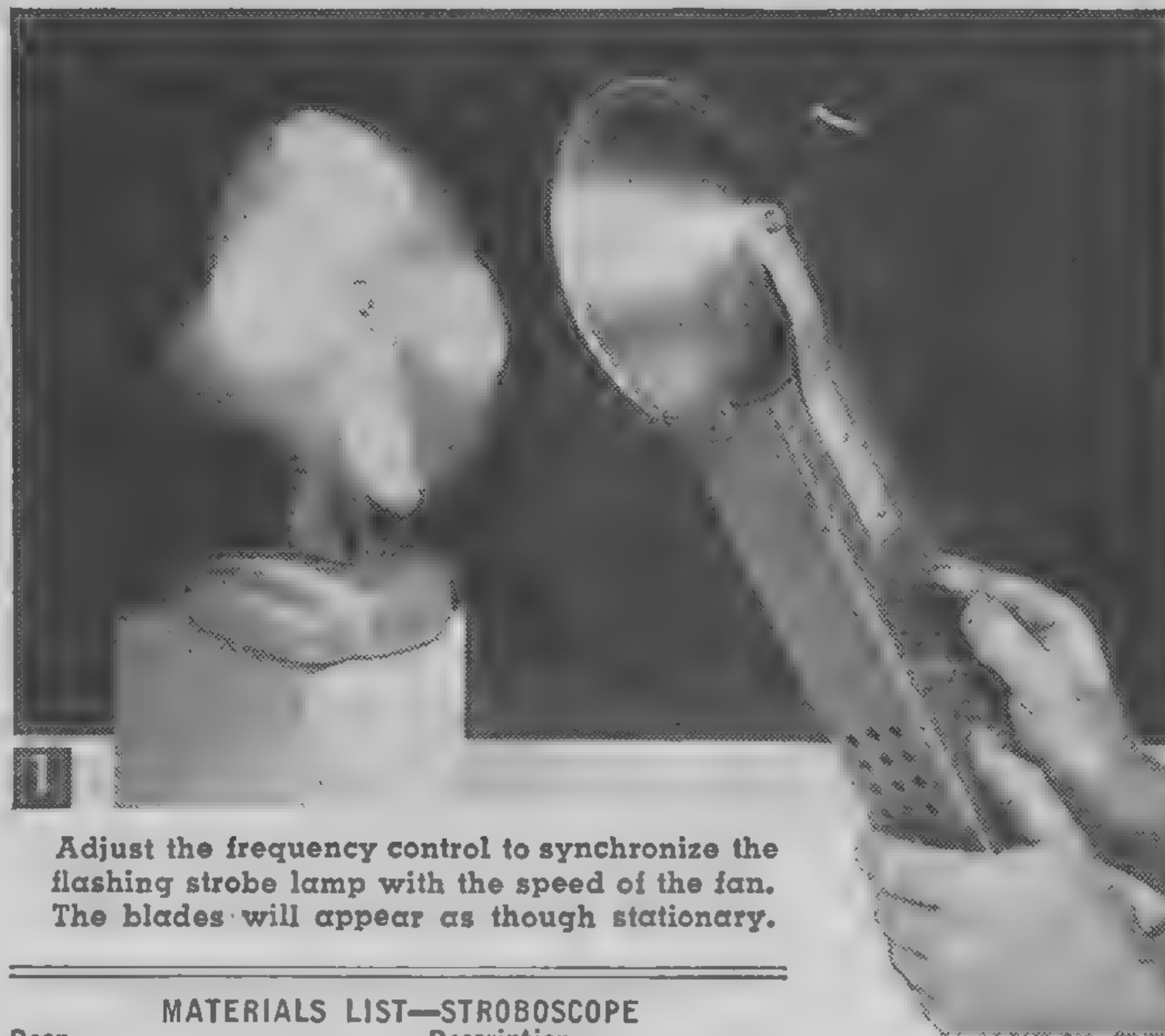
By W. F. GEPHART

WINKING at up to 6,000 flashes per minute, this easily built portable unit will show you fast moving mechanism "stopped," or in slow motion in order to spot wear, vibration or faulty design in power tools, fans, belts, motors, and reciprocating parts.

A simplified version of equipment widely used in industry, this strobe circuit, uses only about \$21 in parts and performs as well as commercial instruments costing over \$100. The rate of flashing is adjustable between 600, and 6,000 rpm, and by doubling up, you can measure any speed above or below this range. Unlike mechanical tachometers, the stroboscope absorbs no power from a direct connection to the moving mechanism itself.

How It Works. The basic principle of the stroboscope is simple. You might, for example, want to examine a fan blade rotating at about 300 rpm, (5 times a second). The blades will be in the same place every successive fifth of a second; therefore, if you could blink your eyes that fast, you would see the fan as though it were standing still. By means of the frequency control, Fig. 1, the rate of flashing is adjusted until it synchronizes exactly with the moving part. Adjust the control to flash slightly faster, or slower, and you can see the movement in slow motion. Reciprocating motions, such as the action of a pump, or the teeth of a high speed jig saw are clearly stopped in action.

If you calibrate your unit against a standard, you will be able to use it as a tachometer to make measurements of the rpm of high speed motors,



Adjust the frequency control to synchronize the flashing strobe lamp with the speed of the fan. The blades will appear as though stationary.

MATERIALS LIST—STROBOSCOPE

Desg.	Description
R1	27 ohm 1 watt 10% carbon resistor
R2	1 megohm 1 watt 10% carbon resistor
R3	7,000 ohm 5 watt wirewound resistor
R4	560K 1/2 watt 10% carbon resistor
R5	1 M 1/2 watt 10% carbon resistor
R6	2M potentiometer (linear taper)
R7	10M 1/2 watt 10% carbon resistor
R8	100K 1/2 watt 10% carbon resistor
R9	5K 5 watt wirewound 5% resistor
R10	10K 5 watt wirewound 5% resistor
R11	2K 5 watt wirewound 5% resistor
C1	8 mfd 450 V electrolytic capacitor
C2	8 mfd 150 V electrolytic capacitor
C3	8 mfd 450 V electrolytic capacitor
C4	.05 mfd 200 V electrolytic capacitor
C5	.033 mfd 200 V paper capacitor
C6	1 mfd. 400 V paper (Sprague 4TM-M1)
C7	20 mfd 450 V (Ill. Cond. IHTE 2045)
SW1	DPST toggle switch
SW2	SPST toggle switch (for range switch)
SR1, SR2, SR3	75 ma 130 RMS selenium rectifiers (IT&T Federal #1003A)
V1, V2	RCA OA2 150 volt voltage regulator tubes
V3	Sylvania 1D21/SN4 Strobotron tube
Misc.	Bud Minibox CU-2114 (12 x 2 1/2 x 2 1/4" aluminum box and cover)
	2 ea. 7 pin miniature sockets, 1 4-prong socket, 1 knob, terminal strips, line cord, reflector, decals, misc. hardware, Walsco Stroboscopic Disc #949

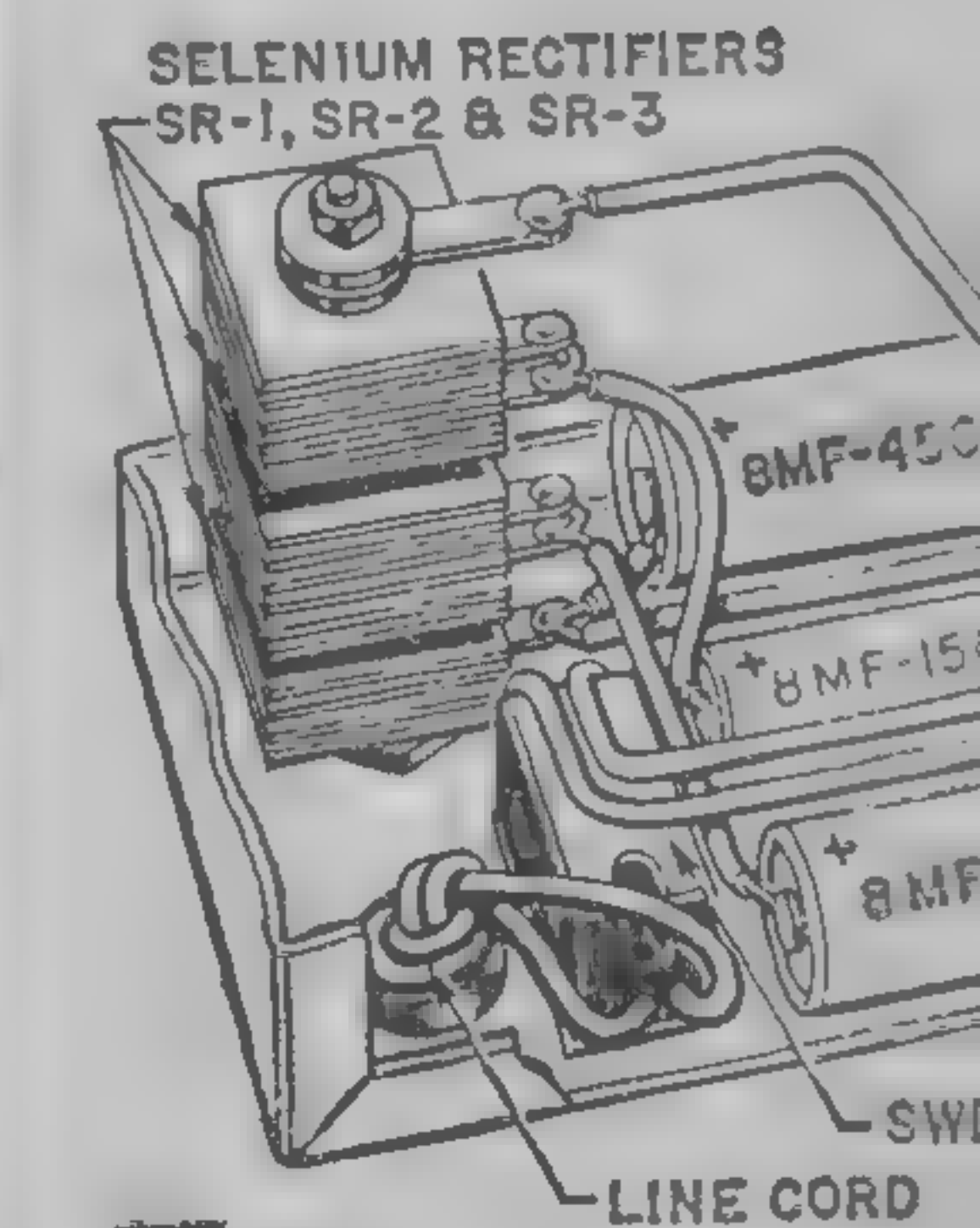
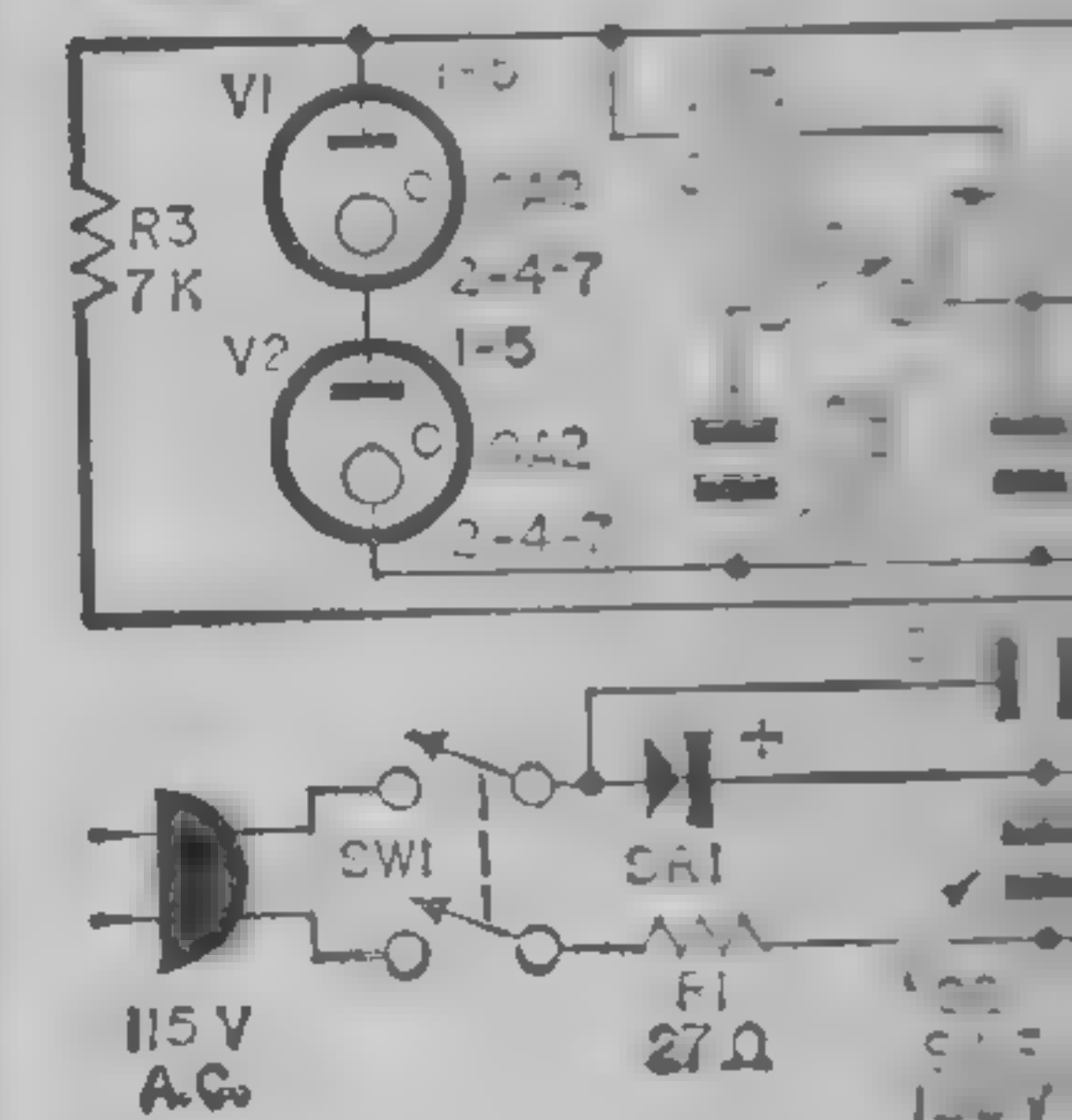
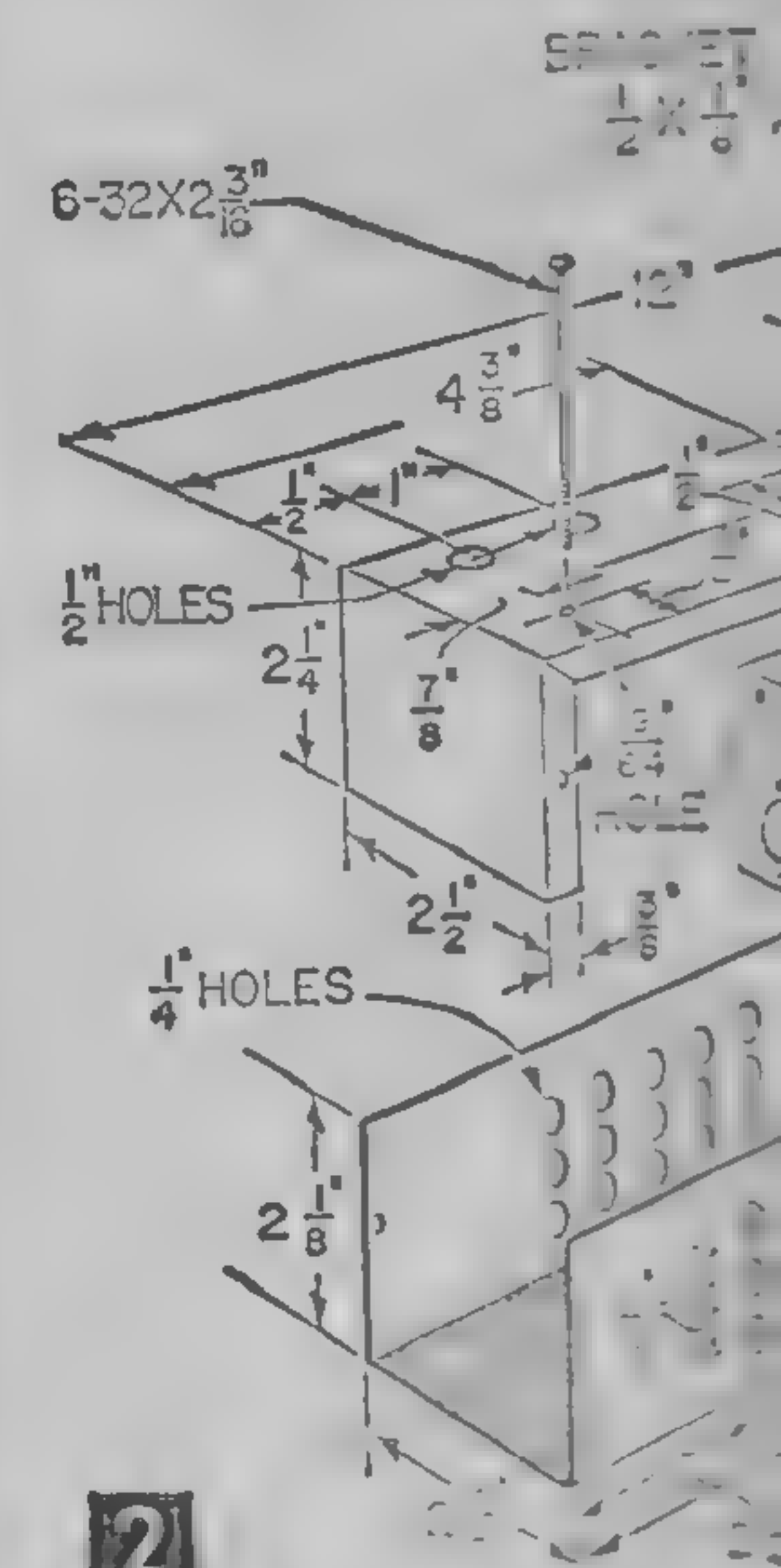
Note: See text and drawing for auxiliary trigger switch parts.

compact aluminum minibox. Mount the strobotron tube socket at one end, and drill the holes for the switches and frequency control in the back, as in Fig. 2. Make the sub chassis of scrap aluminum, and mount all parts including tube sockets, and tie points before starting the wiring. The reflector shown in Fig. 1 is from a used Heiland photo flashgun, and can be obtained in most camera stores. Since the design of the

phono turntables, and even of dental drills. Hobbyists have used strobe lights to check the speed of model gas engines vs. various fuel mixtures. And if your model railroad engine is balky, your strobe may quickly indicate the trouble, in a part that is vibrating at certain speeds.

Building the Case. The stroboscope is completely enclosed in a

bracket will depend on the you obtain, exact dimensions. Simply bend a piece of bar 1/2 x 1/8-in. to focus the directly behind the flashtron tube, which centers the top of the tube. Since the regulator tubes gener-



3 A PICTORIAL

FEBRUARY, 1960



phono turntables, and even of dental drills. Hobbyists have used strobe lights to check the speed of model gas engines vs. various fuel mixtures. And if your model railroad engine is balky, your strobe may quickly indicate the trouble, in a part that is vibrating at certain speeds.

Building the Case. The stroboscope is completely enclosed in a Mount the stroboscope and drill the holes in the sub chassis of all parts including before starting the in Fig. 1 is from a and can be obtained the design of the

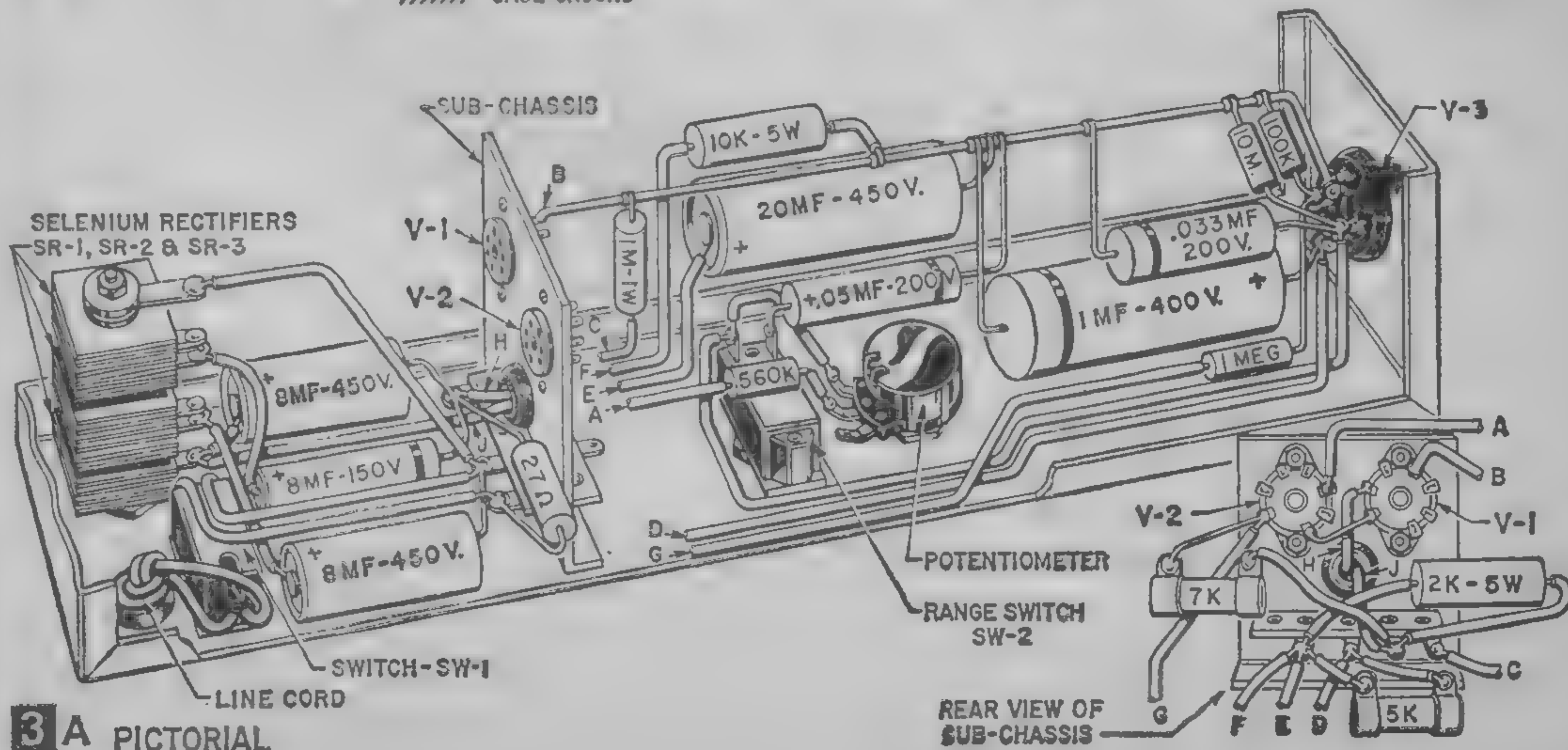
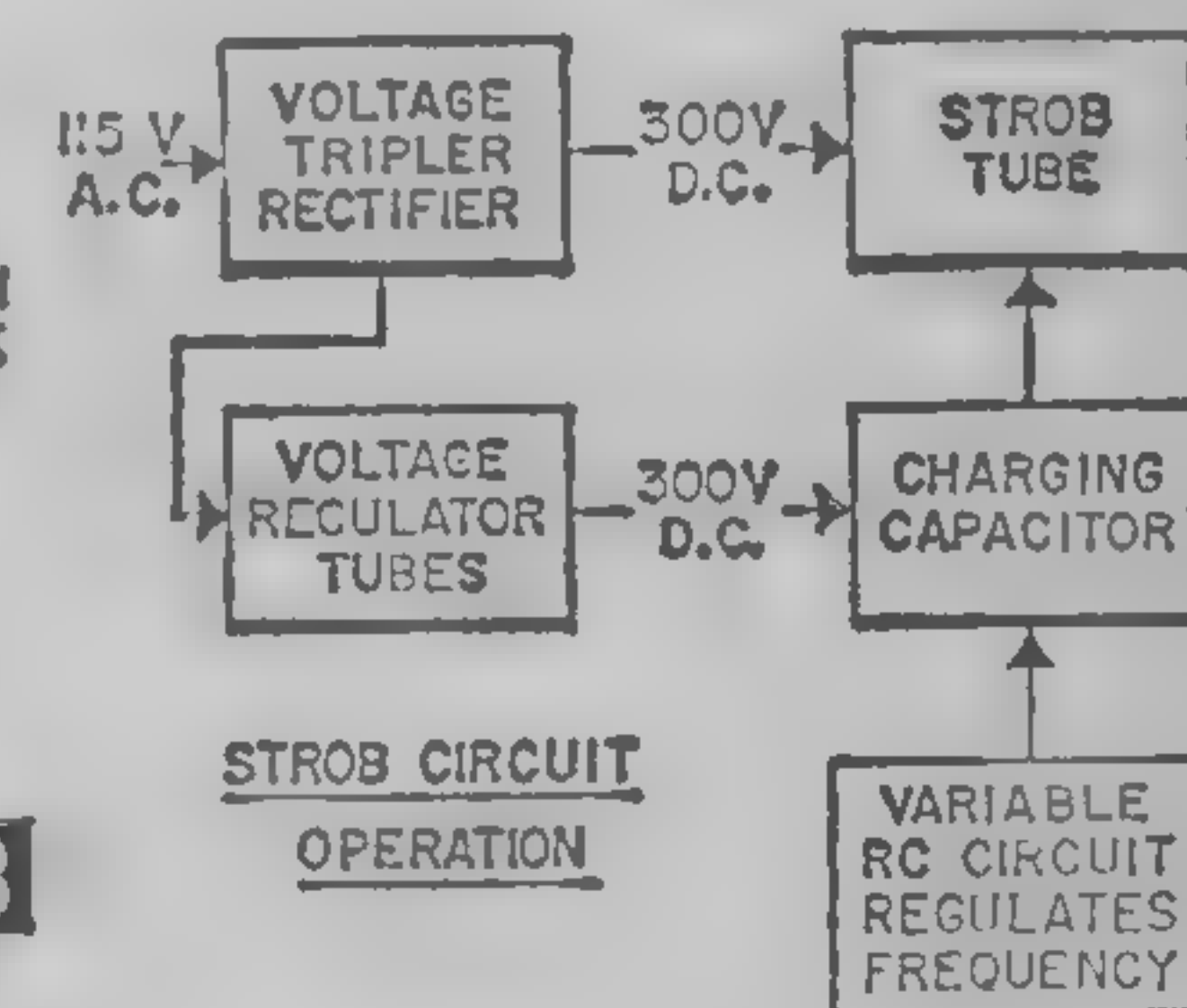
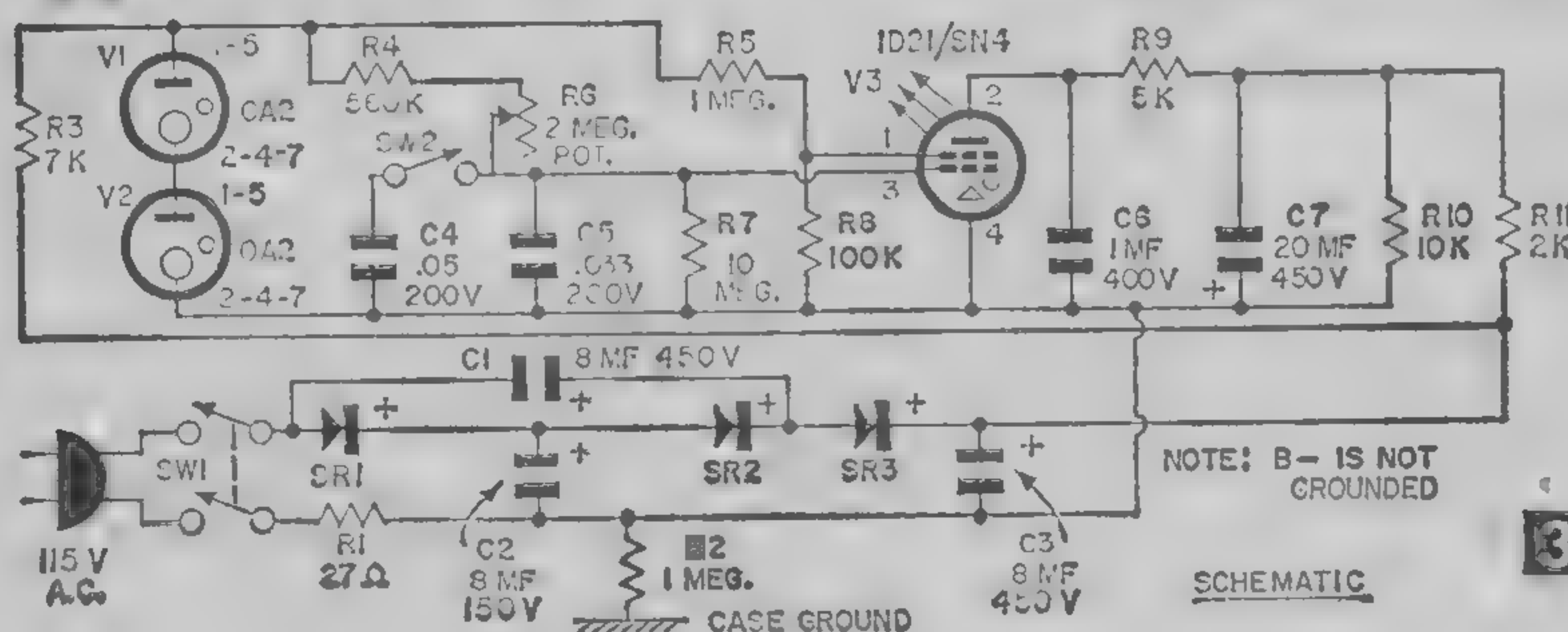
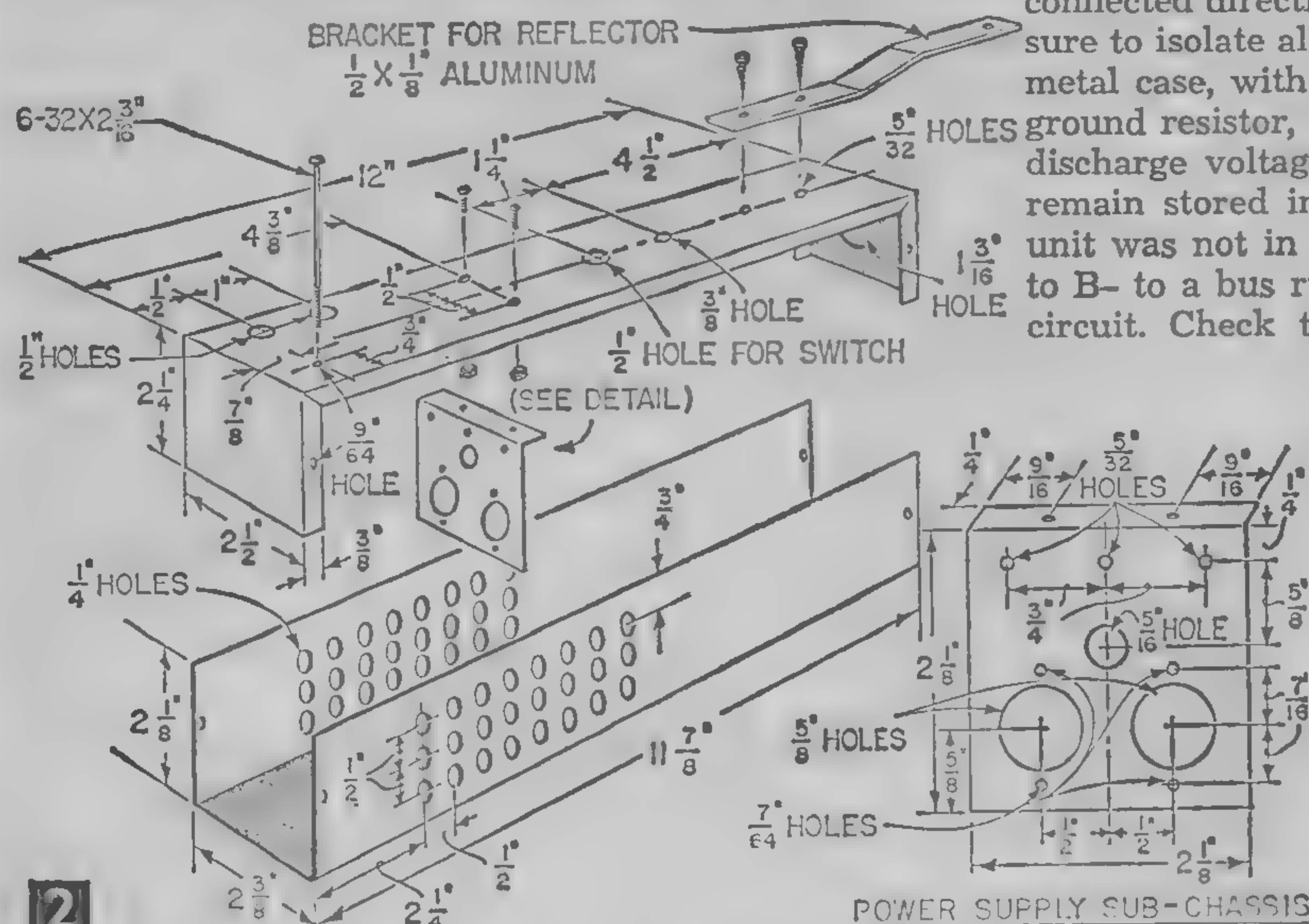
bracket will depend on the kind of reflector that you obtain, exact dimensions are not given. Simply bend a piece of hardened aluminum strap, $\frac{1}{2} \times \frac{1}{8}$ -in. to focus the center of the reflector directly behind the flashing area of the stroboscotron tube, which centers about $\frac{3}{4}$ in. down from the top of the tube. Since the power supply, and the regulator tubes generate heat, drill ventilating

holes near these parts in each side of the cover as in Fig. 2.

Wiring the Circuit. Begin by wiring and testing the power supply, as in Fig. 3. It consists of a selenium rectifier tripler, with an output of about 430 volts, which is subsequently reduced to 300 volts for both the timing and strobe pulse circuits. Since one side of the power supply is connected directly to the a-c power line, be sure to isolate all interior circuits from the metal case, with the exception of the case ground resistor, which acts as a bleeder to discharge voltages which might otherwise remain stored in the capacitors when the unit was not in use. Make all connections to B- to a bus running through the strobe circuit. Check the output voltage of the

power supply before connecting R3 to the regulator tubes. It should be 450 volts or less. If it is higher, increase the value of R3.

CAUTION: High voltages in the power supply, and charges stored in the capacitors can be hazardous. Use extreme care to avoid shock in handling the chassis



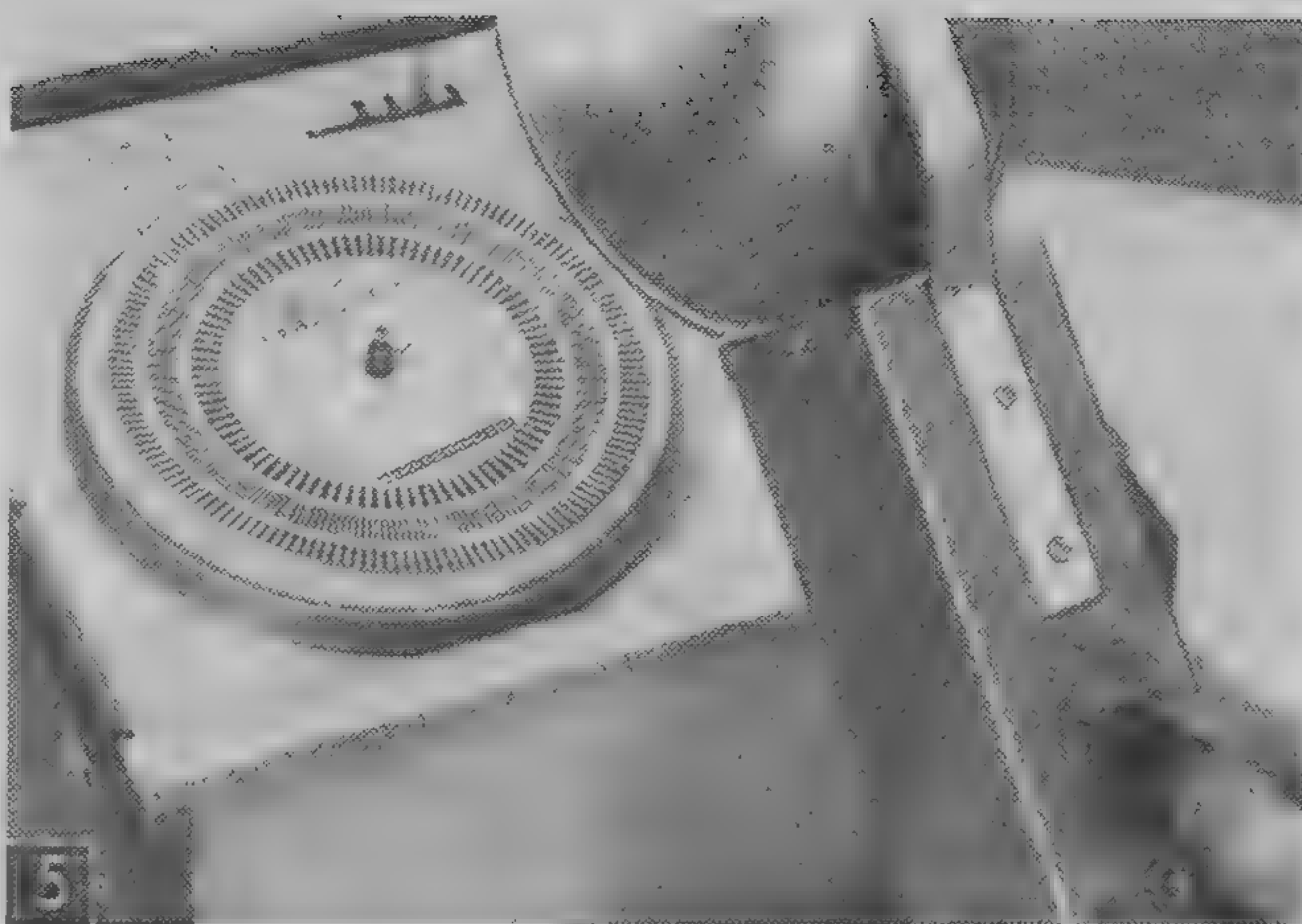
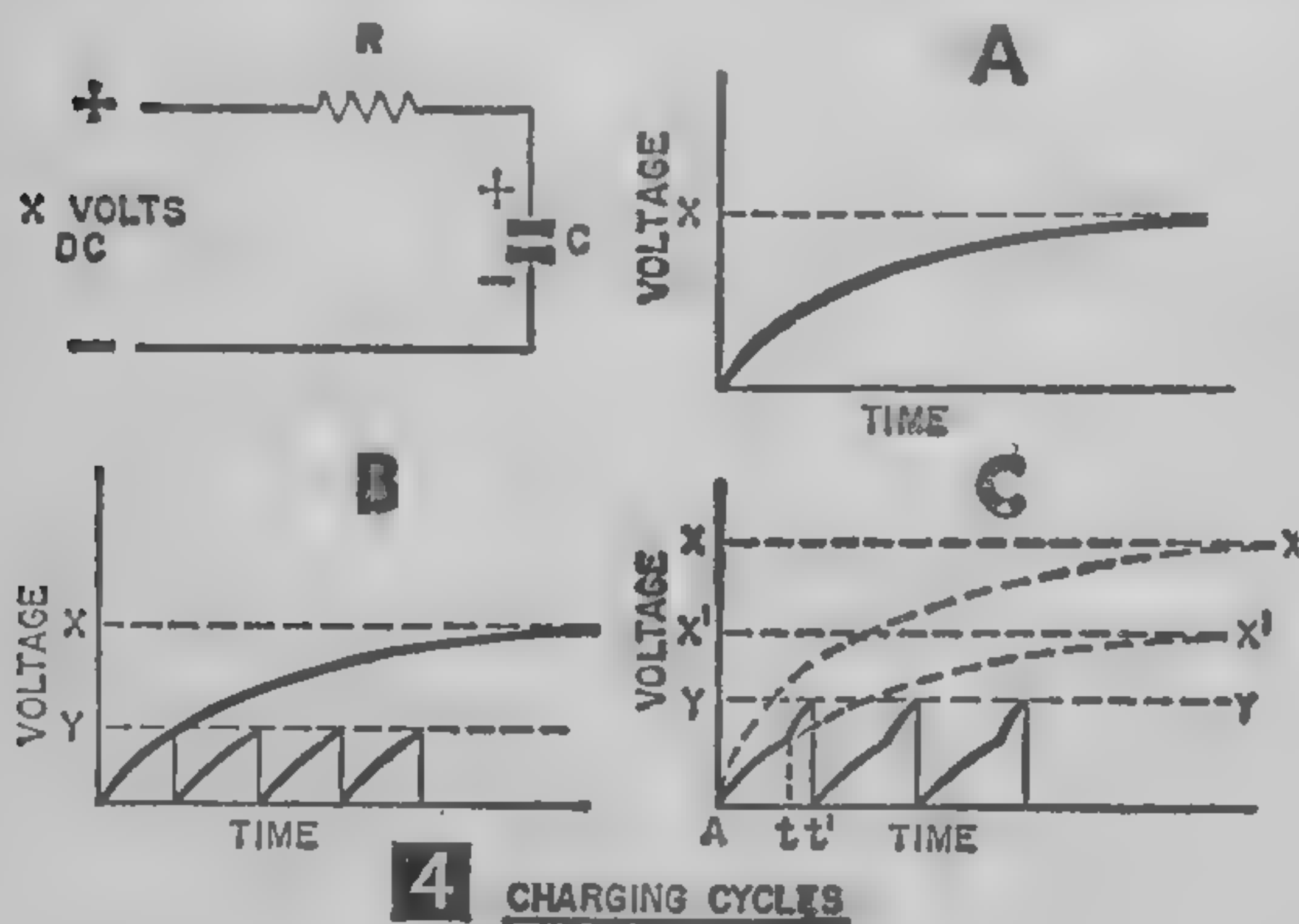
when power is on. Never touch any live parts with bare hands, or non-insulated tools, clips etc.

Next wire the regulator tubes, and the stroboscope section as in the schematic and the pictorial view, taking care to connect the adjustable frequency control R6, so that it has minimum resistance when fully clockwise. Cover all bare wires with spaghetti tubing, and keep the leads to the larger capacitors, C6 and C7, short, so their leads will support them firmly in position.

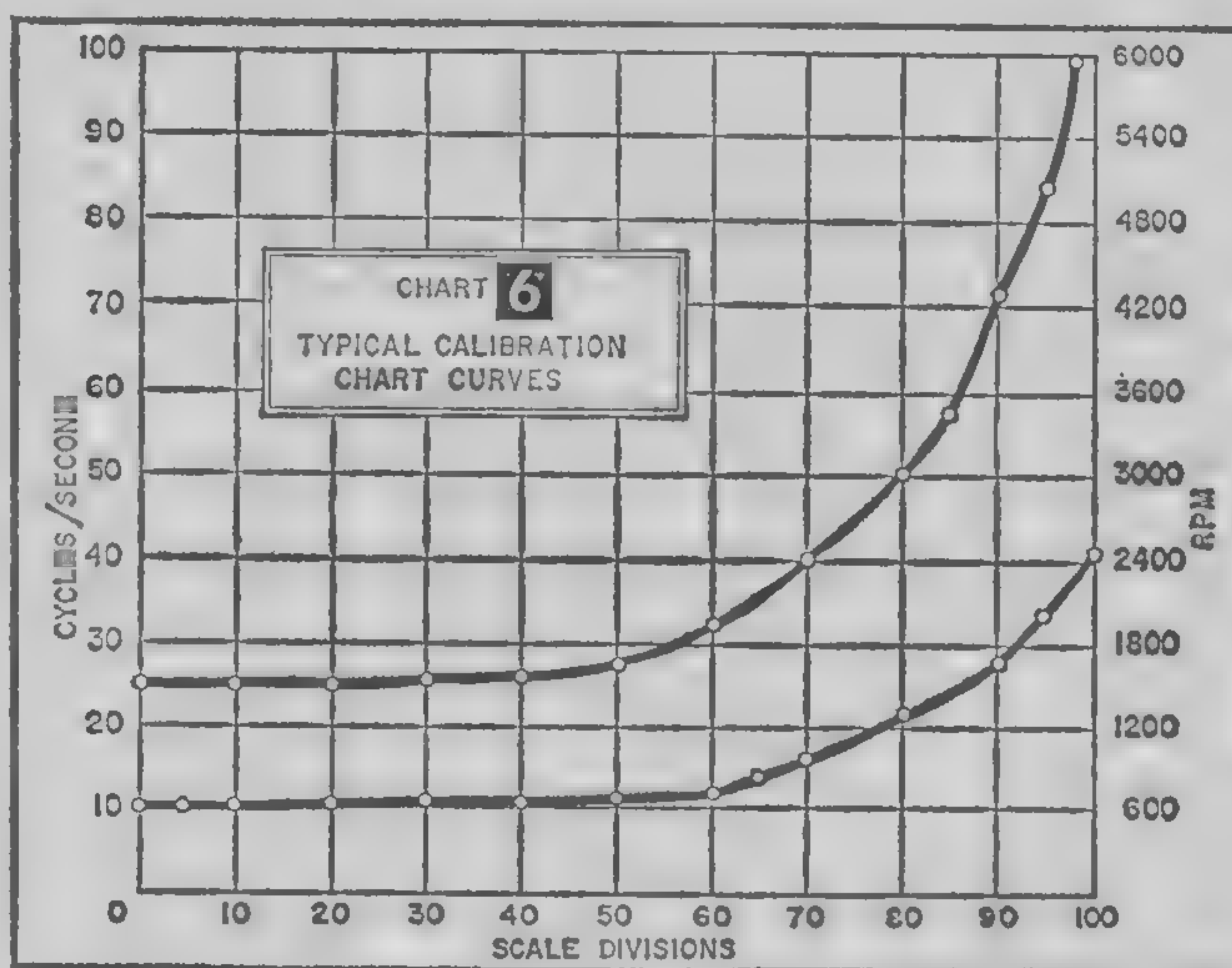
After wiring, check your work carefully against the schematic. Then, turn the unit on. The stroboscotron tube should start firing immediately, with the flashing rate increasing as R6 is turned clockwise. The low and high ranges should overlap slightly; with R6 turned fully counter clockwise on low, the flashing rate should be slightly faster than with R6 fully counter clockwise on high. The strobe tube makes a slight cracking sound as it fires on low rates, and normally makes a steady buzz at higher flashing rates.

The stroboscotron tube operates on the principle of placing a high positive potential on the plate with the cathode grounded. When the difference in voltage between the two grids reaches approximately 100 volts, the gas between the grids ionizes, which in turn "ignites" the gas between the cathode and plate. Once the grid voltages "fire" the tube, the plate takes over control, and the gas remains ionized, with a high current flowing between plate and cathode, until the plate voltage is lowered, even though the voltage difference on the grids is removed.

In this circuit (Fig. 3) the plate resistor and capacitor are used only to prevent the tube from "firing" continually, and the timing between flashes is controlled by changing the grid voltages. The time constant of R9 and C6 is about

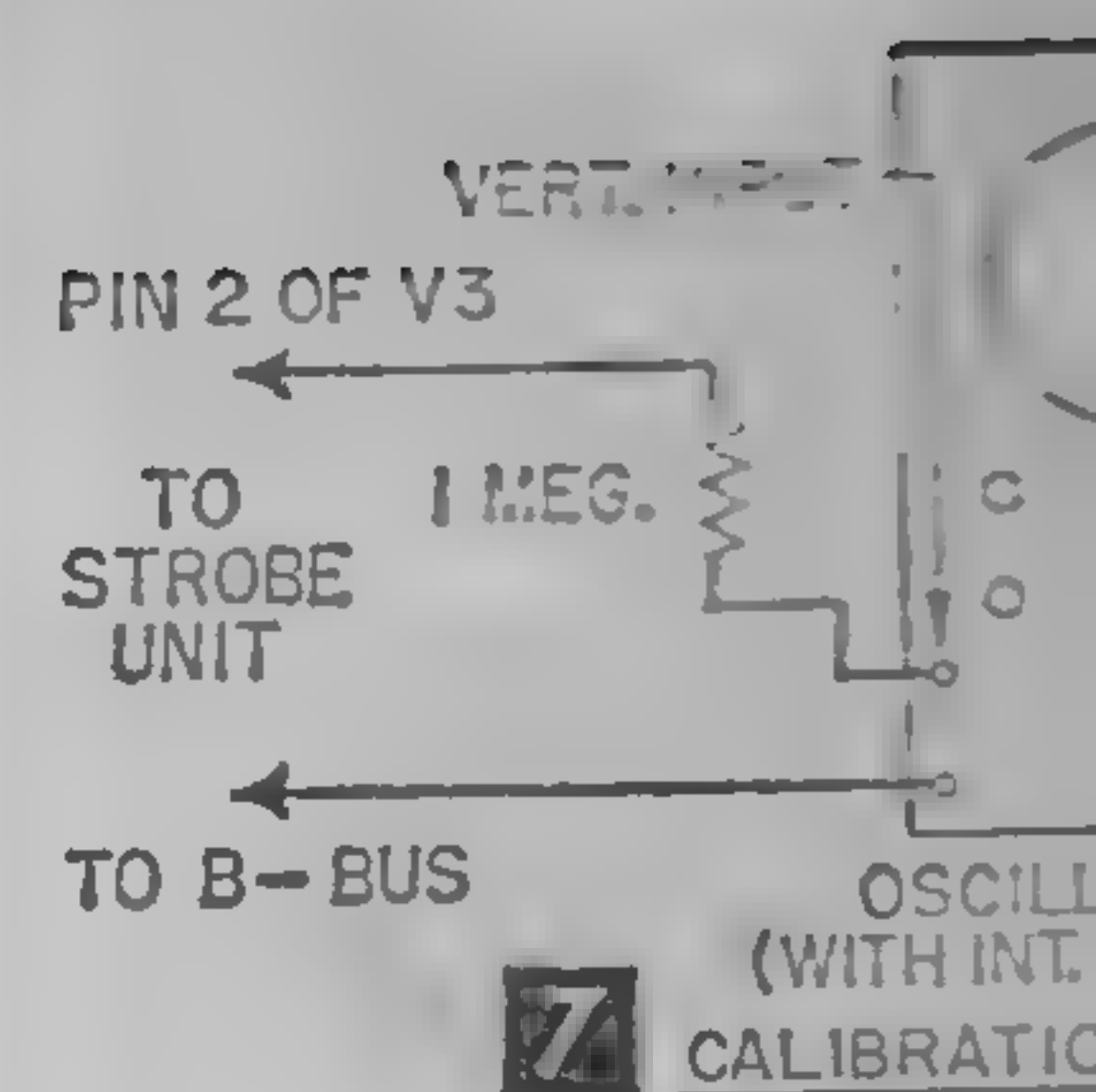


An ordinary record turntable and stroboscopic disc are used to calibrate your strobe light.



.005 second, which is the duration of each flash. The grid voltage difference is controlled by a variable R-C charging circuit consisting of R4, R6, C5, SW2, and C4. When a capacitor charges through a resistor, the voltage across the capacitor increases, as shown in Fig. 4A, until it reaches the charging voltage. Notice that the voltage increases rapidly at first, and then tapers off as it approaches the charging voltage.

If arrangements are made to discharge the capacitor rapidly before it reaches the full charging voltage, a sawtooth wave, as shown in Fig. 4B is formed, and if this voltage "Y" is substantially below the full charging voltage, the curve will be more linear. Repeated charging and rapid discharging gives a series of evenly-spaced peaks, Fig. 4C. Charging of the plate and grid capacitors immediately after firing places a heavy load on the power supply, which would tend to drop the supply voltage and cause a non-linearity in the timing action if this tendency was not minimized by the voltage regulator tubes, V1 and V2.



The time between the stroboscotron charging cycle is constant of the capacitor. The range switch SW2 makes it possible to vary the flashing rate for each range. Wired as a strobe unit will have a flashing rate of 600 cycles per second (600 cps) will cover 25 to 100 cps, and can change the coverage of the value of the grid capacitance. Reducing the charging rate, which can change the maximum flashing rate to pulses per second, (14,400).

It is however impractical to use below 15 cycles per second since persistence of vision makes it possible for the pictures as a movie, with complete construction to identify the controls, a coat of lacquer, or plastic.

Calibrating Your Strobe will be very useful at times to enhance its uses in the laboratory. Rather than calibrate the back of the case directly, make a chart (Fig. 6).

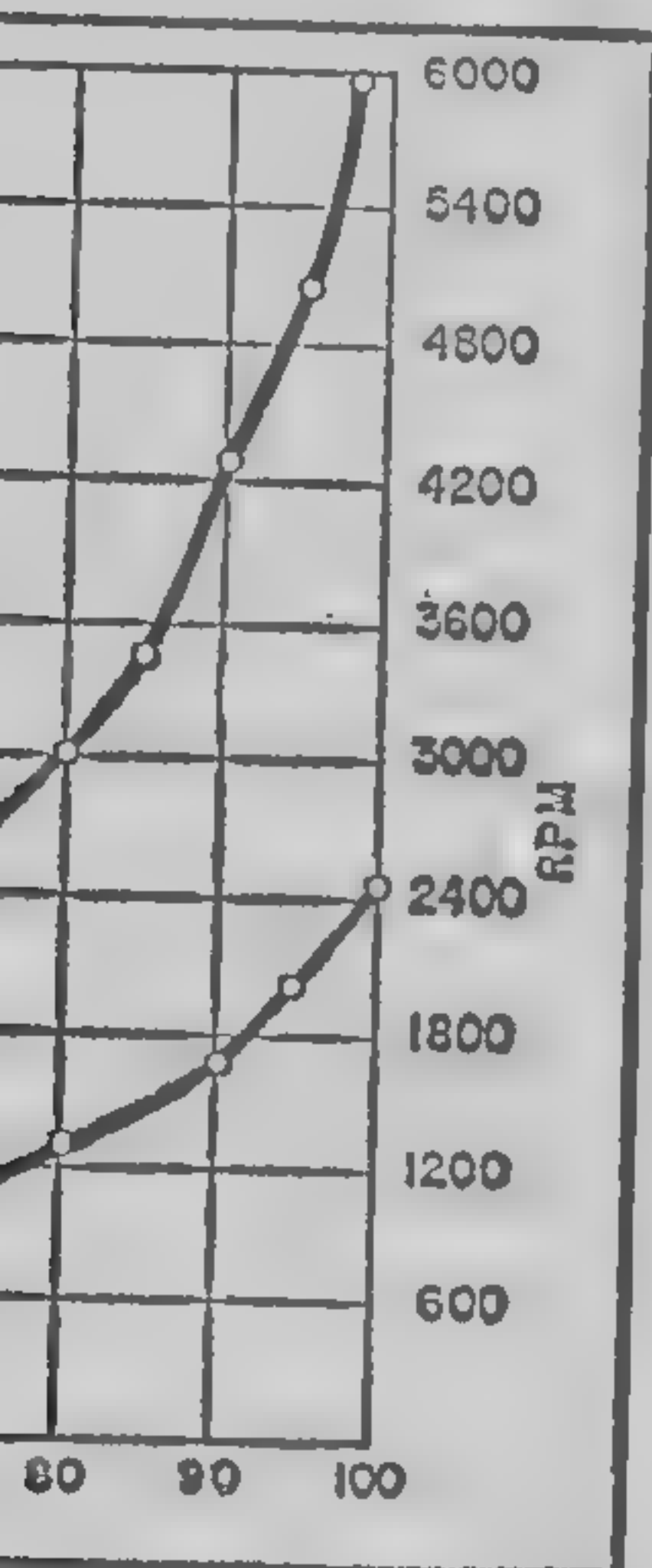
The simpler method is to use a phono turntable, and a stroboscopic disc at record stores (Fig. 5). The disc, with a fluorescent coating, which will flash at exact frequency of your power line.

Now, plug in the stroboscotron, warm up a few minutes, and set the control high, with the control at maximum flashing rate.

Fig. 5, turn the control clockwise until the 78 rpm ring appears. The reading on your chart is 2400 (equal to 3600 rpm). Counting counter clockwise, the next five lower points on the chart are 1800, 1440, and 1080.

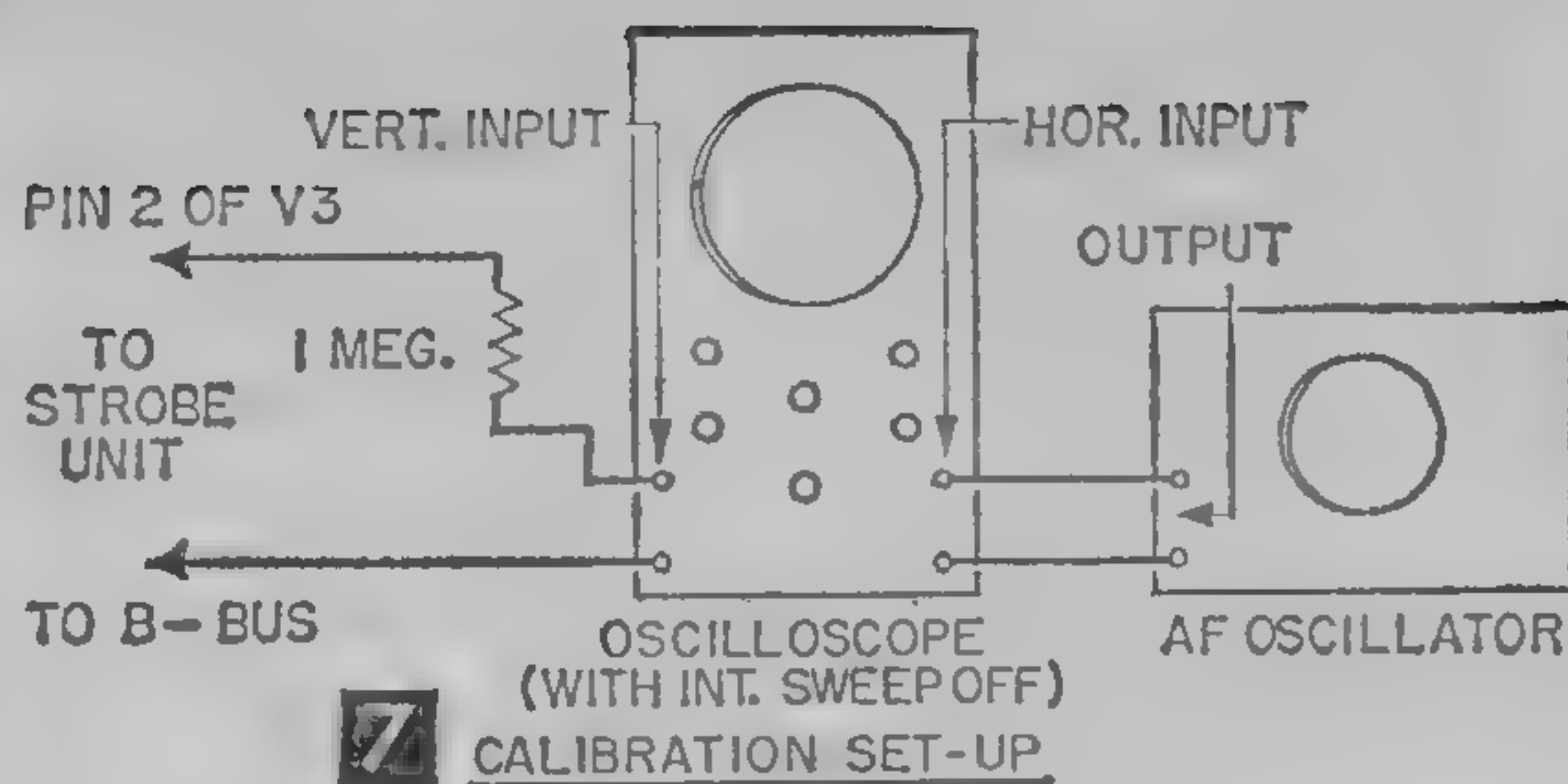


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ation of each flash. ds controlled by a consisting of R4, a capacitor charges across the capac- 4A, until it reaches that the voltage in- ten tapers off as it ge.

to discharge the hes the full charg- as shown in Fig. ge "Y" is substan- voltage, the curve charging and rapid enly-spaced peaks, and grid capacitors a heavy load on l tend to drop the n-linearity in the was not minimized V1 and V2.



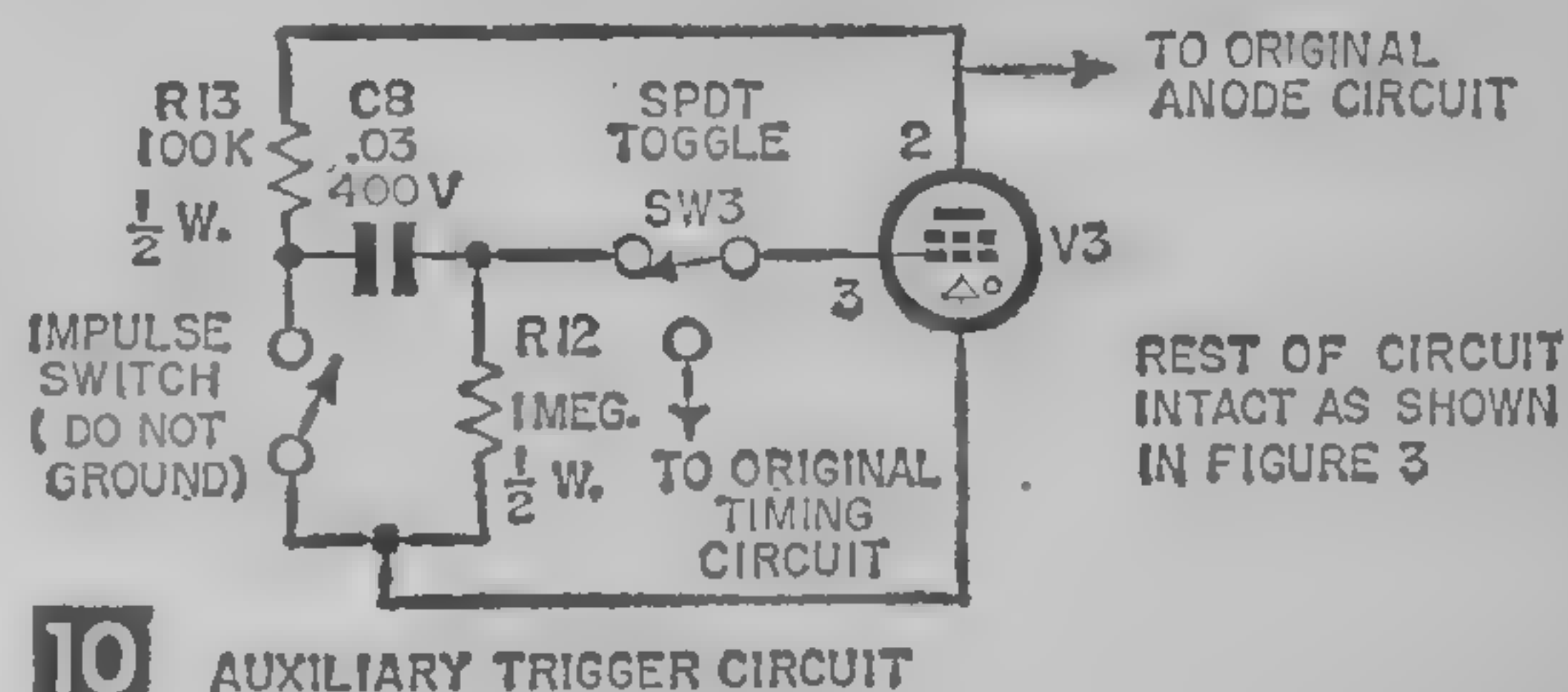
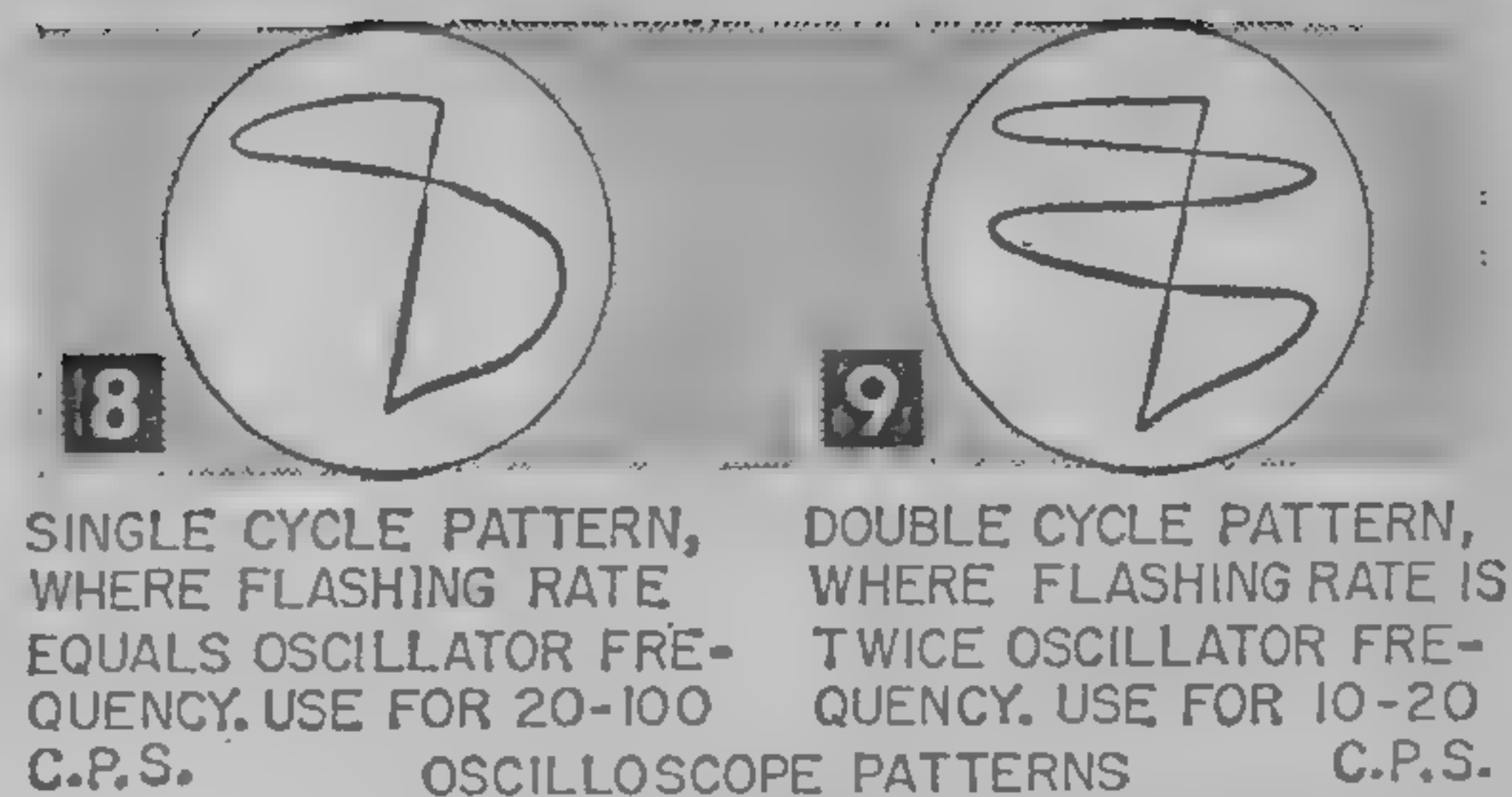
The time between the peaks of the grid capacitor charging cycle is dependent on the time constant of the capacitor and the related resistor. The range switch SW2 provides additional capacity for the low frequency range, and R6 makes it possible to vary the time constant for each range. Wired as in the schematic, your strobe unit will have a low range of 10 to 40 cycles per second (600 to 2,400 rpm) while high will cover 25 to 100 cps, (1,500 to 6,000 rpm). You can change the coverage of the unit by altering the value of the grid circuit resistance and capacitance. Reducing the values increases the charging rate, which can be increased up to the maximum flashing rate of the tube, which is 240 pulses per second, (14,400 rpm).

It is however impractical to use flashing rates below 15 cycles per second for eye observation, since persistence of vision, the principle which makes it possible for us to see a series of still pictures as a movie, would tend to blur the image. Complete construction by applying the decals to identify the controls, and protect them with a coat of lacquer, or plastic spray.

Calibrating Your Strobe. While the stroboscope will be very useful at this point, calibration will enhance its uses in measuring exact speeds. Rather than calibrate the frequency dial on the back of the case directly, it is suggested that you make a chart (Fig. 6). Two methods of calibrating can be used; the latter requires an oscilloscope, and is somewhat more accurate.

The simpler method is to use a 33 $\frac{1}{3}$ and 78 rpm phono turntable, and a stroboscopic disc available at record stores (Fig. 5). Since the accuracy depends on the turntable, check it first, by watching the disc, with a fluorescent lamp, or neon bulb, which will flash at exactly the 60 cycle frequency of your power line. If your turntable is not equipped with a speed adjustment, you can slow it down by loading it with records.

Now, plug in the stroboscope, and allow it to warm up a few minutes. Set the range switch on high, with the control turned clockwise to the maximum flashing rate. Watching the disc, as in Fig. 5, turn the control counter clockwise until the 78 rpm ring appears to stop. Mark this dial reading on your chart, as 60 cycles per second (equal to 3600 rpm). Continuing to turn the dial counter clockwise, the ring will "stop" again at five lower points on your dial corresponding to 2400, 1800, 1440, and 1200 rpm. Repeating these



steps on low range, you will be able to obtain four calibration points representing 1200, 900, 720, and 600 rpm. With all of these points plotted on your graph, you will obtain curves indicating in-between speeds, as in the graph shown in Fig. 6.

CAUTION: Avoid looking directly at the flashing stroboscopy for more than a few moments. The light can be harmful.

The second method of calibrating requires an oscilloscope and an audio oscillator, connected according to Fig. 7, with a 1 megohm resistor input attenuator. Provided that you have constant line voltage, and warm up your equipment beforehand, it will provide more accurate results. Set the oscillator to 100 cps (equal to 6000 rpm) and adjust the strobe control to get a pattern similar to the one shown in Fig. 8. Since rpm is equal to cycles per second times 60, reduce the oscillator frequency in steps and take note of the dial settings, on your graph, required to obtain the scope pattern shown.

At frequencies below 20 cps, adjust the strobe for a two-cycle pattern (Fig. 9) since most oscillators will not go below 20 cps. To calibrate the low range, start with the high end of the scale, with the oscillator set at 40 cps, and adjust the strobe dial for the two cycle pattern. The strobe is then flashing at 20 cps, or 1200 rpm. Establish your curve points downward, using the two cycle pattern.

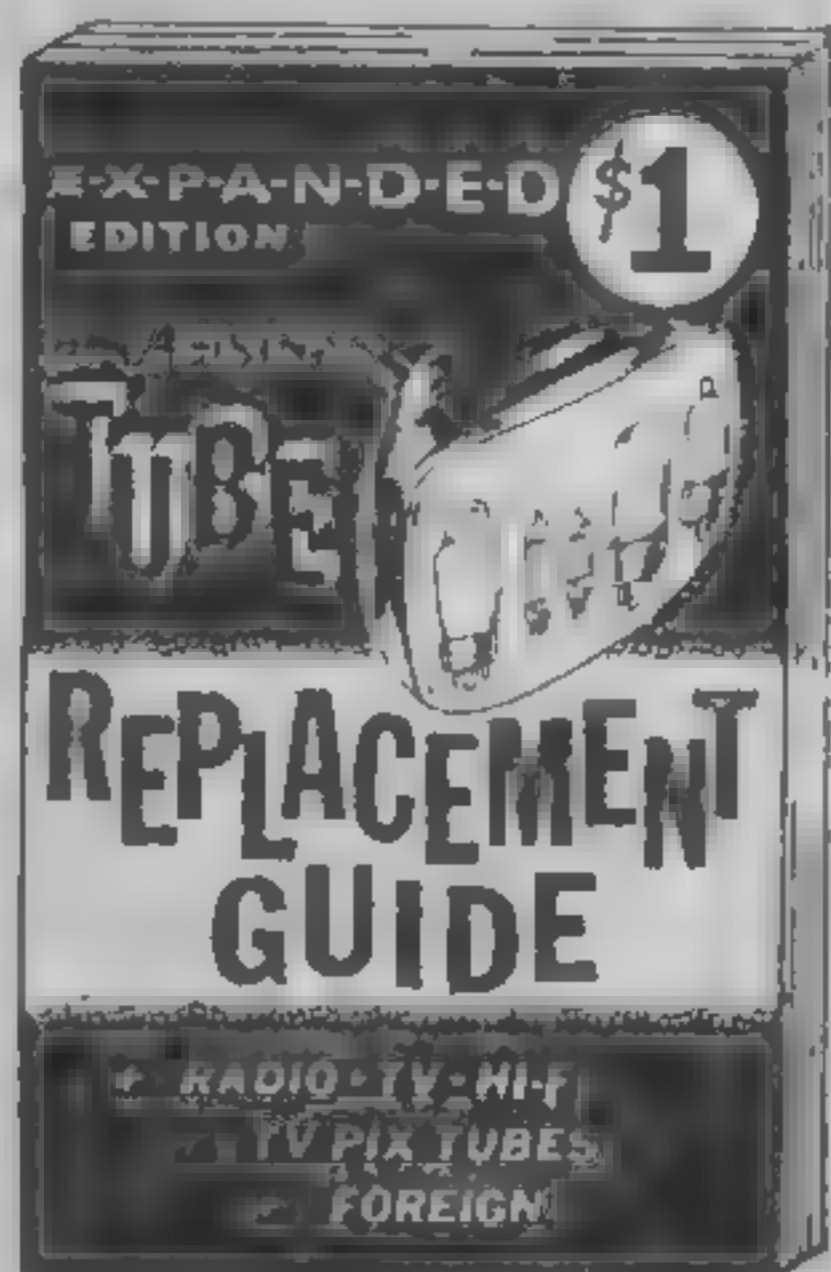
Accessory External Switch. If you wish to observe a motor or mechanism in stopped motion, which is changing speed, you can do it by continuously adjusting the dial, or more conveniently by means of an external switch, and the simple circuit addition shown in Fig. 10. The external switch can operate on a cam, or flattened portion of a shaft. A miniature switch with a nylon contact button which will operate at up to 9,600 rpm, without bounce is offered by Licon Division of Illinois Tool Works (Switch #16-4041).

Tips On Strobe Use. Using the stroboscope, you will notice that often you can "freeze" motion

TUBE REPLACEMENT GUIDE

EVERYONE who uses vacuum tubes NEEDS this new 1960 Expanded Edition **TUBE GUIDE**.

Contains over 2700 substitutes for over 1500 tubes, including radio & TV receiving tubes, tubes used in Hi-Fi & Stereo, foreign tubes and TV picture tubes.



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3123 Gillham Road, Kansas City 9, Missouri

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821—19th Street N.W., Washington 6, D. C.

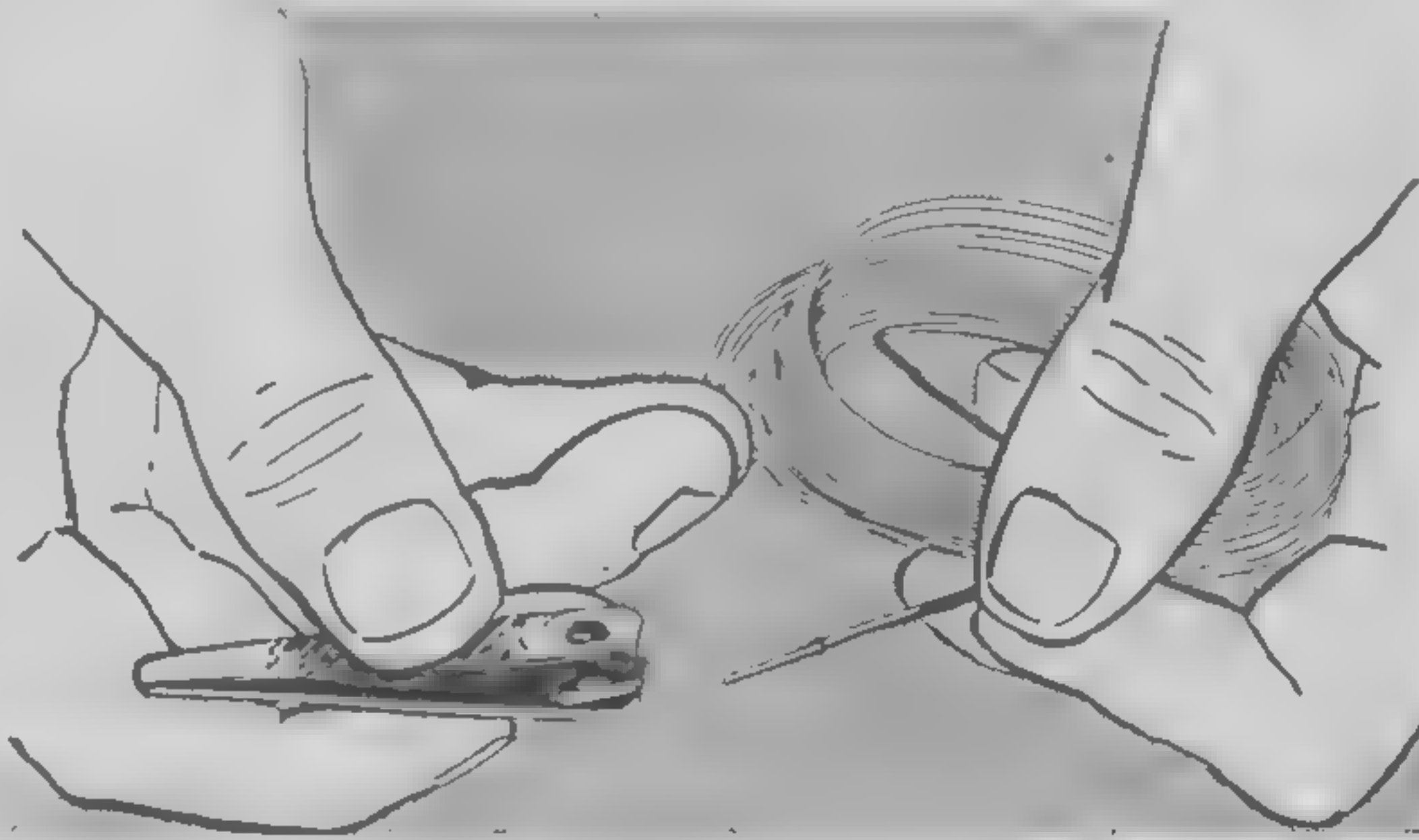
at several different flashing rates which are multiples of the true speed. High speeds above your top flashing rate can be measured as harmonics. Generally the true speed will produce the sharpest image. When measuring motor speeds, engrave or paint a fine line out from the center of the shaft. Harmonic speeds will cause the line to appear at several points.

When adjusting the flashing rate for the true speed of an object, the object will appear to move slowly in its true direction when the lamp is flashing too slowly, and seems to move slowly in the opposite direction when the lamp is flashing too rapidly. If a motor for example, is running at a true speed of 1800 rpm, and your strobe is set at 1801, the image will appear to be rotating slowly at 1 rpm in the direction of the motor rotation.

Stroboscopes have many important uses in industry. Automobile transmissions are checked while running at the factory. Tool and appliance manufacturers use the strobe to set the speed of small motors, and vibrators. Saws, cutting blades and rotating tools can be observed in action. Fast moving paper in printing presses can be inspected. Vibration and backlash in gear trains, as well as in ultra-high speed mechanisms such as gyroscopes can be easily seen and thus the stroboscope points the way to the remedy.

Nail Clipper Strips Wire

• A nail clipper makes an excellent tool for radio and TV hobbyists, to use for removing insulation from small-gage wiring. First, however, remove

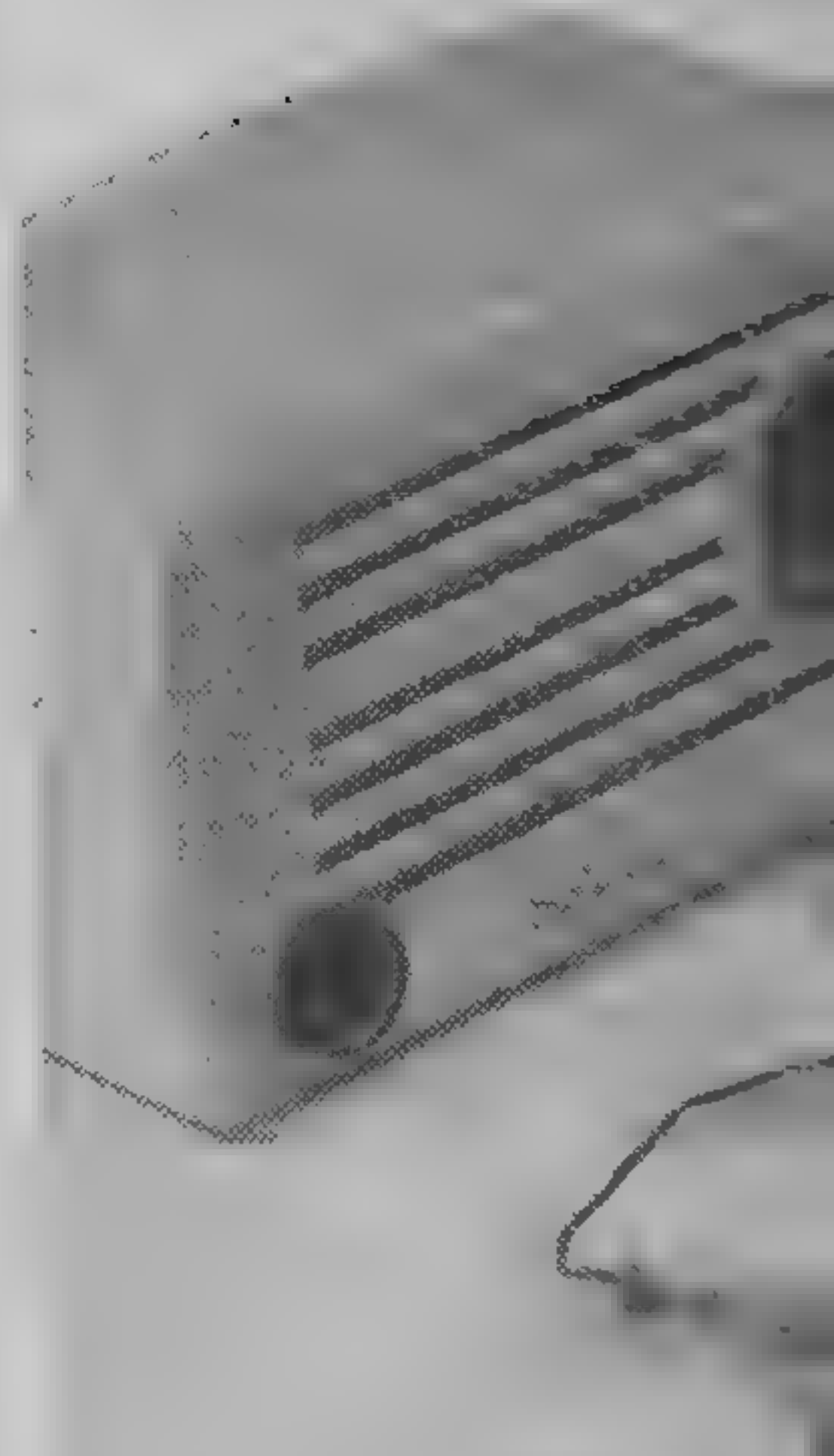


the pressure-handle to avoid exerting too much force and cutting right through the wire.—R. J. DECRISTOFORO.

Save Those Dirty Radio Parts

• When dirty tube sockets, insulators, knobs, tuning capacitors and other metal, bakelite or ceramic radio parts won't come clean in ordinary cleaning solutions, try this idea. Allow the parts to soak a minute or two in a pan of boiling hot water to which a capful of liquid dishwashing detergent has been added, then brush them with a vegetable brush. This won't damage the parts in any way but will remove stubborn dirt, grease, and grime that would otherwise produce considerable signal loss at radio frequencies.—JOHN A. COMSTOCK.

"Hop-Up"



You'll be surprised at how it performs when coupled to a tuned circuit.

DO you want to listen to a station despite a nearby? Do you want the best transmitter that ever was weak and full of noise? This is for you.

A long, outside antenna factory with the usual since it often spoils the end. A simple antenna used with an outside selectivity and coupletively. Result: No motion smear, and the stick their heads above

Obtain a cardboard from a bathroom tissue eter and at least 3½ in. are not critical, and make Carefully close-wind No. 24 copper magnet is best but enamelled taps on this coil at 50

Connect this coil in a capacitor of 360-mmfd variable capacitor has work satisfactorily. (I salvaged from the junction.) Mount the coil ¾ x 4 x 4 in. softwood antenna tuner is complete There are two ways

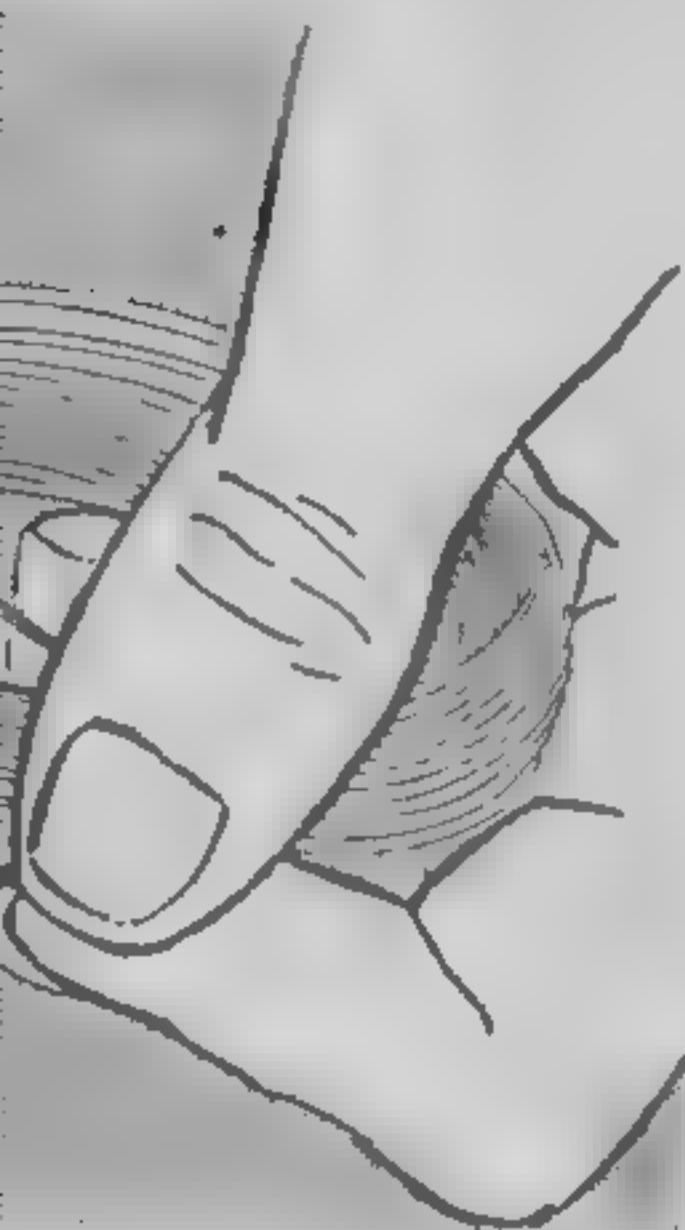
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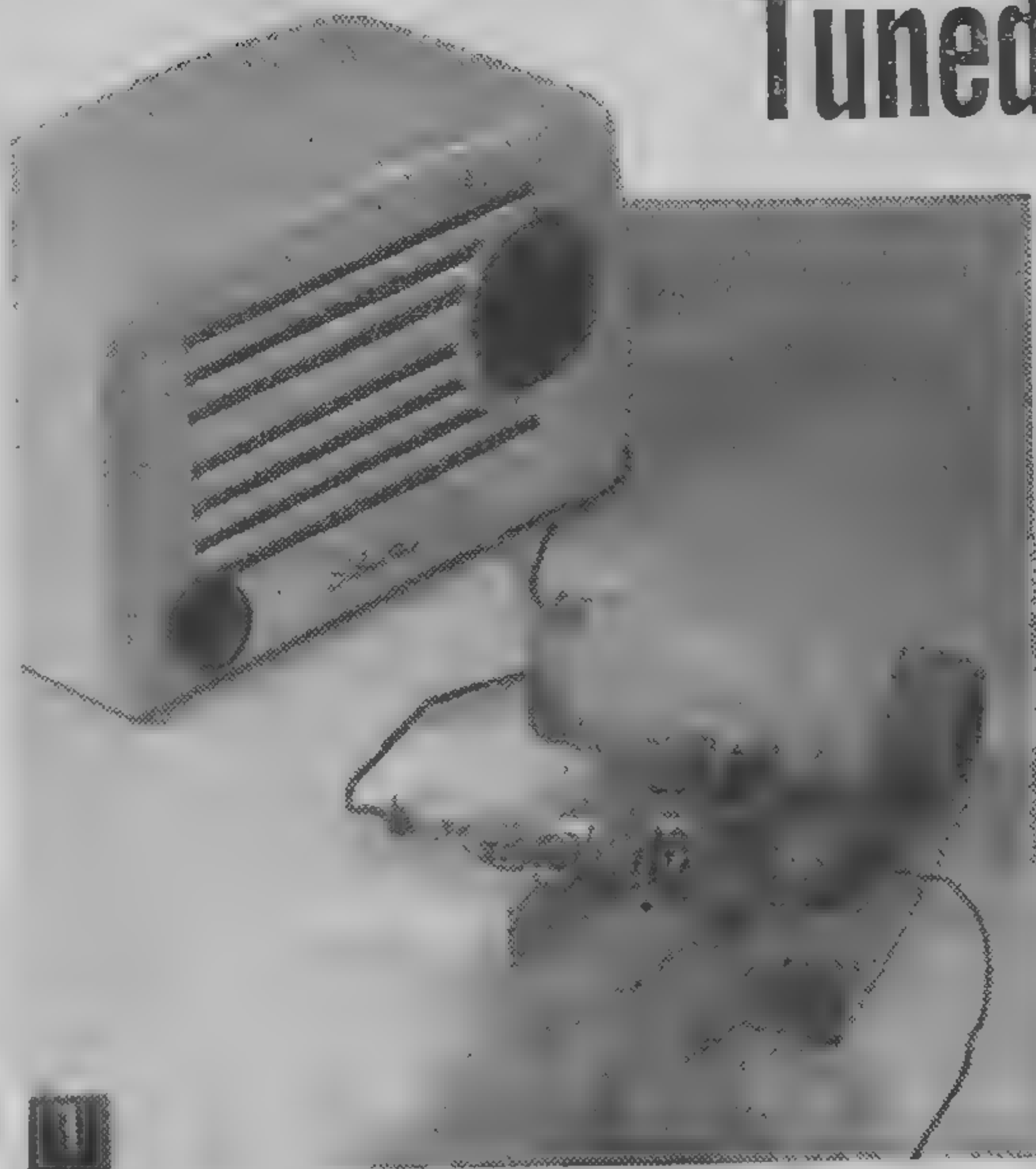


erting too much
the wire.—R. J.

Radio Parts

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"Hop-Up" That Small Radio with a Tuned Antenna Coupler



You'll be surprised at how well your small receiver performs when coupled to an outdoor antenna with a tuned antenna coupler.

DO you want to listen to that distant 250-watt station despite a 5000-watter blasting away nearby? Do you live so far from the nearest transmitter that even your local reception is weak and full of noise? If so, this simple gadget is for you.

A long, outside antenna seldom proves satisfactory with the usual small broadcast receiver, since it often spoils the selectivity of the front-end. A simple antenna tuner, such as this unit, used with an outside antenna, will restore this selectivity and couple the circuits more effectively. Result: No more "birdies," or local station smear, and the little ones from far away stick their heads above the mud.

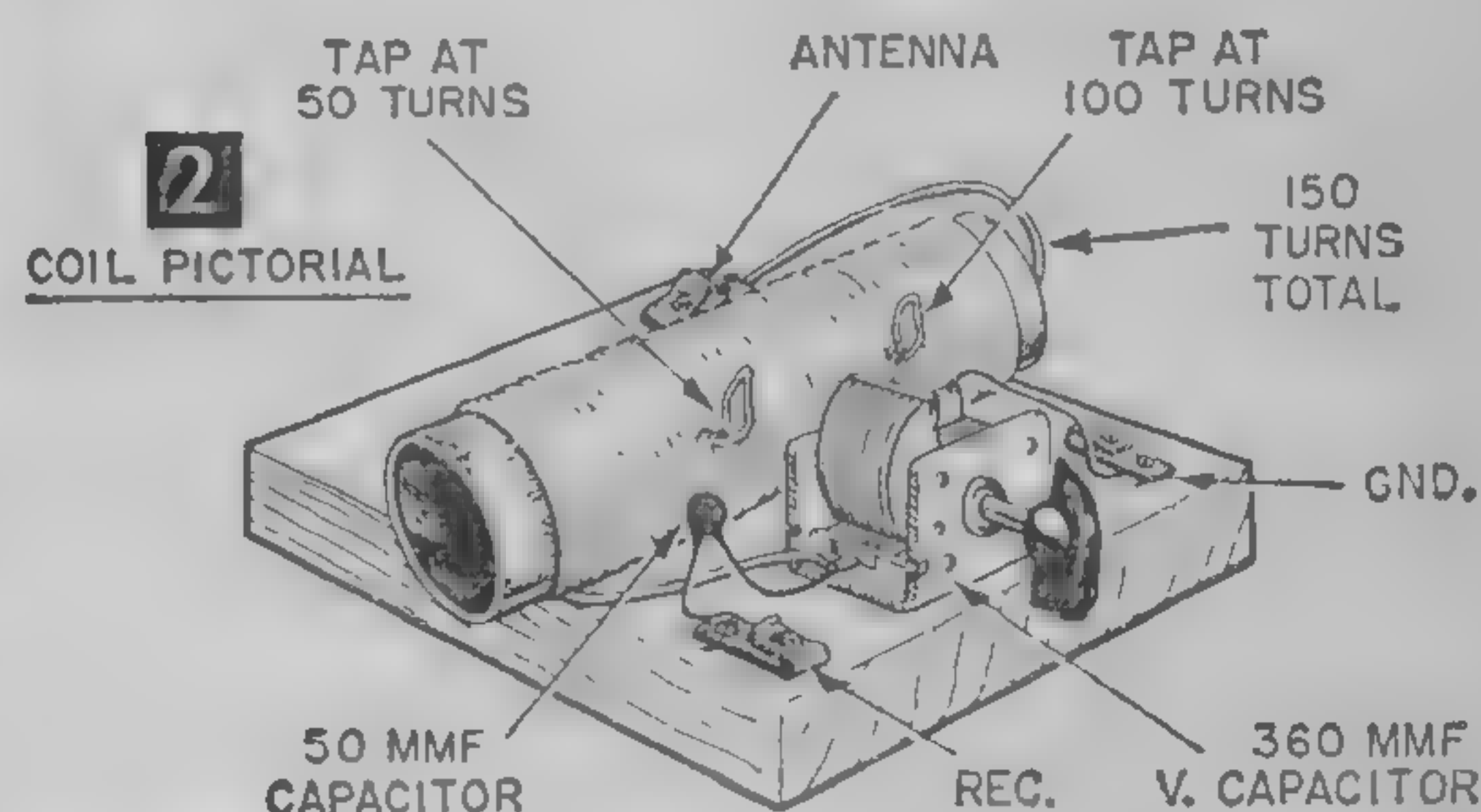
Obtain a cardboard mailing tube, or a core from a bathroom tissue roll about 1½ in. in diameter and at least 3½ in. long. (The dimensions are not critical, and may vary ½ in. either way.) Carefully close-wind on this tube 150 turns of No. 24 copper magnet wire. Cotton-covered wire is best but enamelled wire will do. Arrange for taps on this coil at 50 and 100 turns (see Fig. 2).

Connect this coil in series with a variable capacitor of 360-mmf maximum capacitance. Any variable capacitor having this capacitance will work satisfactorily. (If you use a two-gang unit, salvaged from the junkpile, use only one section.) Mount the capacitor and coil upon a ¾ x 4 x 4 in. softwood board (see Fig. 2), and your antenna tuner is complete.

There are two ways to connect this tuner to

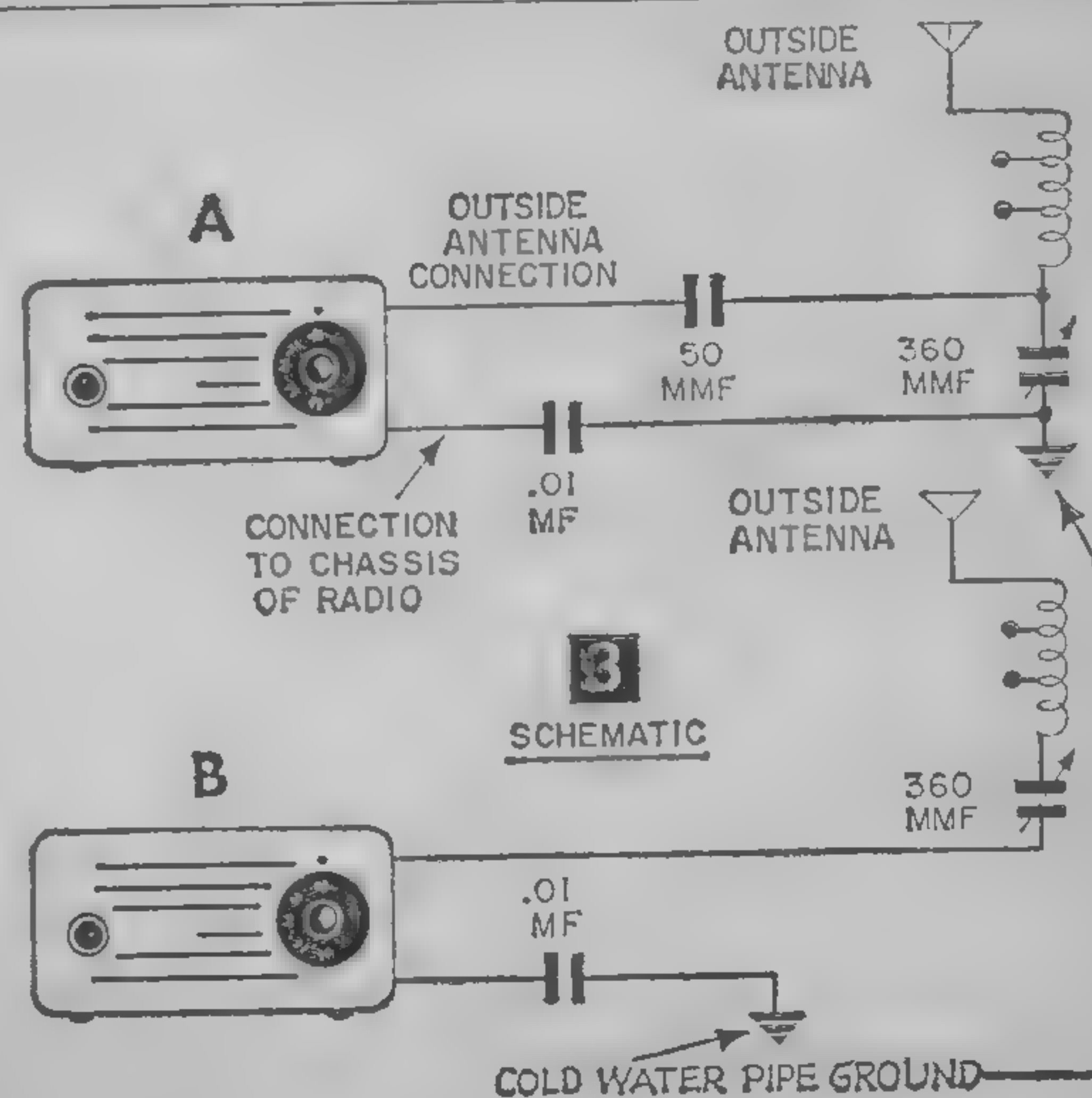
your radio, depending upon the impedance of its input circuit. Try both connections, the one giving the sharpest tuning and the greatest signal boost will be immediately evident. The connection shown in Fig. 3A is for high-impedance, 3B for low impedance inputs.

Use a well-insulated outdoor antenna with a total length of 60 to 150 ft. A good cold-water pipe ground should also be used. Set the radio dial to the frequency of the weak station you wish to hear and rotate the variable capacitor knob until it peaks to maximum volume. Then readjust radio tuning for best signal quality. Clip the antenna clip on the coil tap that gives best results.—C. F. ROCKEY.



MATERIALS LIST—ANTENNA COUPLER

No. Req'd	Description
1	variable capacitor, 360 mmf. max.
1	Mueller spring battery clip, miniature size
1	knob, for variable capacitor
¼#	No. 24 magnet wire, cotton-covered or enamelled
1	0.01 mfd., 200 w.v. paper capacitor
1	50 mmf., disc-type ceramic capacitor





Miniature Greenhouse for Growing Orchids

How to produce perfect orchids in your living room

By DONALD W. ROBINSON

ONCE considered a tropical plant, the orchid is now grown successfully in many homes in temperate and cool climates. In return for beautiful blooms, its only special requests are close temperature and humidity controls and freedom from drafts. These conditions are easily met when you build this miniature greenhouse. You can place it on a table near a source of home heat and natural light, or attach wrought-iron legs for easy mobility. I used 28-in. legs so the bottom of the greenhouse cleared the radiator and the glass was in line with the window.

Greenhouse Construction. Begin by making

This table-top greenhouse will enable you to grow orchids and other tropical flora in any sunny, heated room. Note the vacuum-cup-type thermometer attached to back glass panel.

the bottom unit (Fig. 2B) from $\frac{3}{4} \times 7\frac{1}{2}$ -in. white pine, butt-joining pieces with #8 $\times 1\frac{1}{2}$ -in. *fh* screws countersunk flush. In the front panel saw out three air-inlet holes to receive 3-in. dia. radio escutcheons (obtainable at radio-parts stores). Also saw out a slot to receive a 4-in. wide escutcheon in which will be inserted a cabinet pull and bolt with which to slide the ventilator (Fig. 2B).

Now, make the top unit from $\frac{3}{4} \times 1\frac{3}{4}$ -in. white pine (Fig. 2C) and the cover unit from $\frac{3}{4} \times \frac{3}{4}$ -in. white pine (Fig. 2D). To assemble cover unit, butt-join with *Weldwood Contact Cement* and attach $\frac{1}{2} \times 1\frac{1}{2}$ -in. brass corner angles, notching front and back members to receive angle leg flat (Fig. 2D).

Cut four $\frac{1}{8} \times \frac{3}{4} \times \frac{3}{4}$ -in. aluminum angles to serve as vertical supports of top and bottom units. Drill #33 holes to receive #4 $\times \frac{5}{8}$ -in. *fh* aluminum or plated screws, countersunk flush, and attach angles (Figs. 2B and C). Next, cut $\frac{1}{8} \times \frac{3}{4} \times \frac{3}{4}$ -in. aluminum angles for top and bottom units to hold glass enclosures. Drill #33 holes to receive #4 $\times \frac{5}{8}$ -in. *fh* aluminum or brass screws countersunk flush, and attach angles to top and bot-

bottom units. These angles butt flush against vertical members (Figs. 2B and C). Stain inside wood surfaces to suit your taste and, when dry, apply one or more coats of water-resistant varnish.

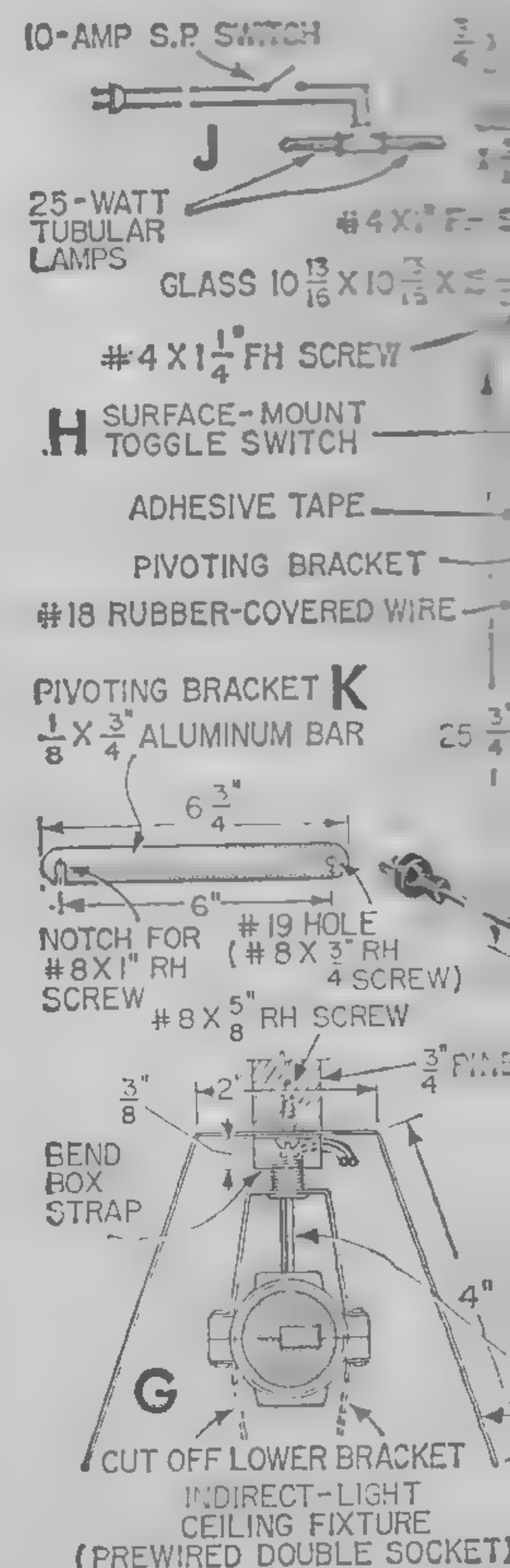
From 1/8-in. tempered hardboard, cut a sliding ventilator and saw out air-inlet holes to match front panel holes (Fig. 2E). Bore a hole to receive the cabinet-pull bolt and attach ventilator to pull through front-panel slot. Make two angle guides for ventilator from .025-in. aluminum sheet or flashing stock (Fig. 2B), and attach to top back of front panel with aluminum or brass #4x3/8-in. rh screws. Make

the 16 1/4 x 32 1/2-in. base (exterior grade); install 1/4-round to base as a flange. Bore = 19 holes. Screws countersunk flush with bottom unit.

To contain glass encl
 $\frac{1}{8} \times \frac{3}{4} \times \frac{3}{4}$ -in. aluminum
 ing corners and peak.
 cut a $32\frac{1}{2}$ -in. length
 and shape as in Fig. 2D
 with $\#4 \times \frac{1}{2}$ -in. fh alu
 countersunk flush alon
 "gable" end, attach $\frac{1}{8}$
 hold glass, mitering f
 butt flush against angl

Attach indirect-light socket to bottom of rid aluminum reflector from 2F and G). Splice 7-cord to prewired fixture run cord through a hole unit. Attach a surface (Fig. 2H), connecting cord down edge of vertical attachment plug cap.

Now insert glass panes in top or bottom-unit angles, and seal with 1/2-in. 1/4-rounds to top and bottom. Weldwood Contact Cement



board, cut a sliding air-inlet holes to (2E). Bore a hole and attach vent-panel slot. Make motor from .025-in. stock (Fig. 2B), front panel with 4 screws. Make

the 16 $\frac{1}{4}$ x32 $\frac{1}{2}$ -in. base from $\frac{1}{2}$ -in. fir plywood (exterior grade); brad a 31-in. length of $\frac{1}{2}$ -in. $\frac{1}{4}$ -round to base as a guide for sliding ventilator. Bore #19 holes to receive #8x1-in. fh screws countersunk flush, and attach base to bottom unit.

To contain glass enclosure for the cover, use $\frac{1}{8} \times \frac{3}{4} \times \frac{3}{4}$ -in. aluminum angles (Fig. 2F), mitering corners and peak. To support ridge angle cut a $32\frac{1}{2}$ -in. length of $\frac{3}{4} \times 1\frac{1}{4}$ -in. white pine and shape as in Fig. 2L, and attach ridge angle with #4 $\times \frac{1}{2}$ -in. fh aluminum or plated screws countersunk flush along back edge. At each "gable" end, attach $\frac{1}{8} \times \frac{3}{4}$ -in. flat aluminum to hold glass, mitering front and back edges to butt flush against angles (Fig. 2F).

Attach indirect-light fixture with a double socket to bottom of ridge piece, first making an aluminum reflector from .025-in. sheet (Figs. 2F and G). Splice #18 rubber-covered line cord to prewired fixture leads, tape splice and run cord through a hole bored in side of top unit. Attach a surface-mount toggle switch (Fig. 2H), connecting as in Fig. 2J, and run cord down edge of vertical support to a rubber attachment plug cap.

Now insert glass panels. Remove either top or bottom-unit angles, set glass in place in body of greenhouse and replace angles. Cement three 1/2-in. 1/4-rounds to top and bottom angles with Weldwood Contact Cement to hold glass in

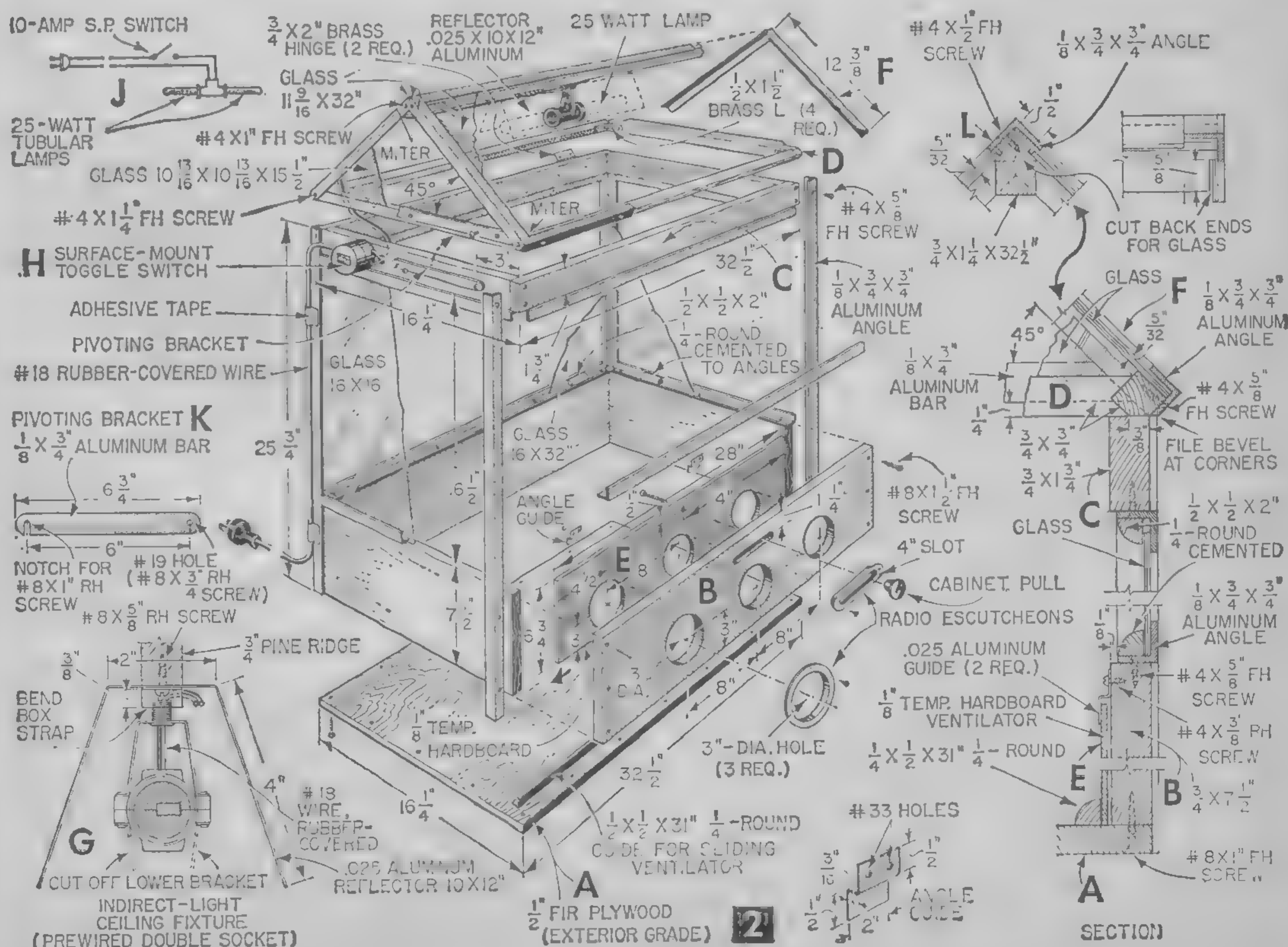
place. Remove one gable end from cover (Fig. 2F), slide in front and back glass panels and replace gable end. Insert glass in gable ends, cementing molding to angles to hold glass.

Hinge cover by attaching two $\frac{3}{4} \times 2$ -in. brass cabinet butt hinges to back of top unit and cover angle (Fig. 2D). To hold cover in a raised position, make a pivoting bracket from $\frac{1}{8} \times \frac{3}{4}$ -in. flat aluminum (Fig. K) and attach so as to engage #8x1-in. *rh* aluminum or plated screw in cover side (Fig. 2D). Pivot bracket with a #8x $\frac{3}{4}$ -in. *rh* screw. If various raised positions are desired, attach several *rh* screws in cover side, spacing to suit.

For ease in checking temperature readings, attach a vacuum-cup-type auto thermometer to inside of glass enclosure (Fig. 1). This type of thermometer is usually furnished with a capsule containing glycerine which, applied to the glass, affords better adhesion. Lacking glycerine, moisten cup edges with water.

Orchid Culture. There are many types and species of orchids, but the *Cattleya* (the purple or white corsage flower) is universally recommended for the beginner. This is the easiest to grow and the best known and accepted, important factors if you intend to build up a small business.

Purchase blooming-age plants which, with proper care, will bloom once each year. These cost about \$7.50 each, although you may be as



MATERIALS LIST—ORCHID GREENHOUSE

No. Req.	Size and Description	Use
1 pc	exterior-grade fir plywood, $\frac{1}{2}$ x $16\frac{1}{4}$ x $32\frac{1}{2}$ "	base
1 pc	tempered hardboard, $\frac{1}{8}$ x $6\frac{3}{4}$ x 28 "	sliding ventilator
	White Pine	
2 pcs	$\frac{3}{4}$ x $7\frac{1}{2}$ x $32\frac{1}{2}$ "	front and back (bottom unit)
2 pcs	$\frac{3}{4}$ x $7\frac{1}{2}$ x $14\frac{3}{4}$ "	sides (bottom unit)
2 pcs	$\frac{3}{4}$ x $1\frac{3}{4}$ x $32\frac{1}{2}$ "	front and back (top unit)
2 pcs	$\frac{3}{4}$ x $1\frac{3}{4}$ x $14\frac{3}{4}$ "	sides (top unit)
2 pcs	$\frac{3}{4}$ x $\frac{3}{4}$ x 31 "	front and back (cover unit)
2 pcs	$\frac{3}{4}$ x $\frac{3}{4}$ x $16\frac{1}{4}$ "	sides (cover unit)
1 pc	$\frac{3}{4}$ x $1\frac{1}{4}$ x $32\frac{1}{2}$ "	ridge (cover)
8 ft	$\frac{1}{2}$ " $\frac{1}{4}$ -round molding	glass holders and ventilator guide
4 ft	$\frac{1}{4}$ " $\frac{1}{4}$ -round molding	glass holders (cover)
	Glass (window single-weight)	
2 pcs	16 x 32"	front and back
2 pcs	16 x 16"	sides
2 pcs	$11\frac{1}{16}$ x 32"	front and back (cover)
2 pcs	$10\frac{1}{16}$ x $10\frac{1}{16}$ x $15\frac{1}{2}$ "	gable ends (cover)
	Aluminum (from hardware store)	
4 pcs	angles, $\frac{1}{8}$ x $\frac{3}{4}$ x $\frac{3}{4}$ x $25\frac{3}{4}$ "	uprights
4 pcs	angles, $\frac{1}{8}$ x $\frac{3}{4}$ x $\frac{3}{4}$ x $31\frac{1}{4}$ "	front and back (top and bottom units)
4 pcs	angles, $\frac{1}{8}$ x $\frac{3}{4}$ x $\frac{3}{4}$ x 15 "	sides (top and bottom units)
2 pcs	angles, $\frac{1}{8}$ x $\frac{3}{4}$ x $\frac{3}{4}$ x $32\frac{3}{4}$ "	front and back (cover)
4 pcs	angles, $\frac{1}{8}$ x $\frac{3}{4}$ x $\frac{3}{4}$ x $12\frac{3}{8}$ "	gable ends (cover)
1 pc	angle, $\frac{1}{8}$ x $\frac{3}{4}$ x $\frac{3}{4}$ x $31\frac{1}{4}$ "	ridge (cover)
2 pcs	bar, $\frac{1}{8}$ x $\frac{3}{4}$ x 16" (approx.)	ends (cover)
1 pc	bar, $\frac{1}{8}$ x $\frac{3}{4}$ x $6\frac{3}{4}$ "	pivoting bracket
1 pc	sheet, .025 x 10 x 12"	lamp reflector
2 pcs	sheet, .025 x $13\frac{1}{16}$ x 2"	ventilator guides
	Miscellaneous	
1	ceiling indirect-light, prewired fixture with double socket	
1	ceiling-box strap	
2	25-watt frosted tubular lamps	
1	surface-mount S.P., 10-amp., 125-v toggle switch	
1	rubber attachment plug cap	
1	#18 rubber-covered wire, length to suit	
3	3"-dia. radio escutcheons and screws	
1	4"-slot radio escutcheon and screws	
1	cabinet pull with rh threaded bolt	
4	$\frac{1}{2}$ x $1\frac{1}{2}$ " brass corner angles	sliding ventilator cover
2	$\frac{3}{4}$ x 2" brass cabinet butt hinges and screws	
1	vacuum-cup-type auto thermometer (auto accessories store)	
4	wrought-iron legs (optional, available at hardware store)	
20	#8 x 1" fh wood screws	bottom attachment
20	#8 x $1\frac{1}{2}$ " fh wood screws	top and bottom-unit attachment
66	#4 x $\frac{5}{8}$ " fh aluminum or plated wood screws	angles and bar attachment
4	#4 x $\frac{1}{2}$ " fh aluminum or plated wood screws	ridge-angle attachment
2	#8 x $\frac{5}{8}$ " rh aluminum or brass wood screws	fixture attachment
2	#8 x 1" rh aluminum or plated wood screws	pivoted bracket
1	#8 x $\frac{3}{4}$ " rh aluminum or plated wood screw	bracket pivot
4	#4 x $\frac{3}{8}$ " rh aluminum or brass wood screws	ventilator-brackets attachment
1 tube	Weldwood Contact Cement	

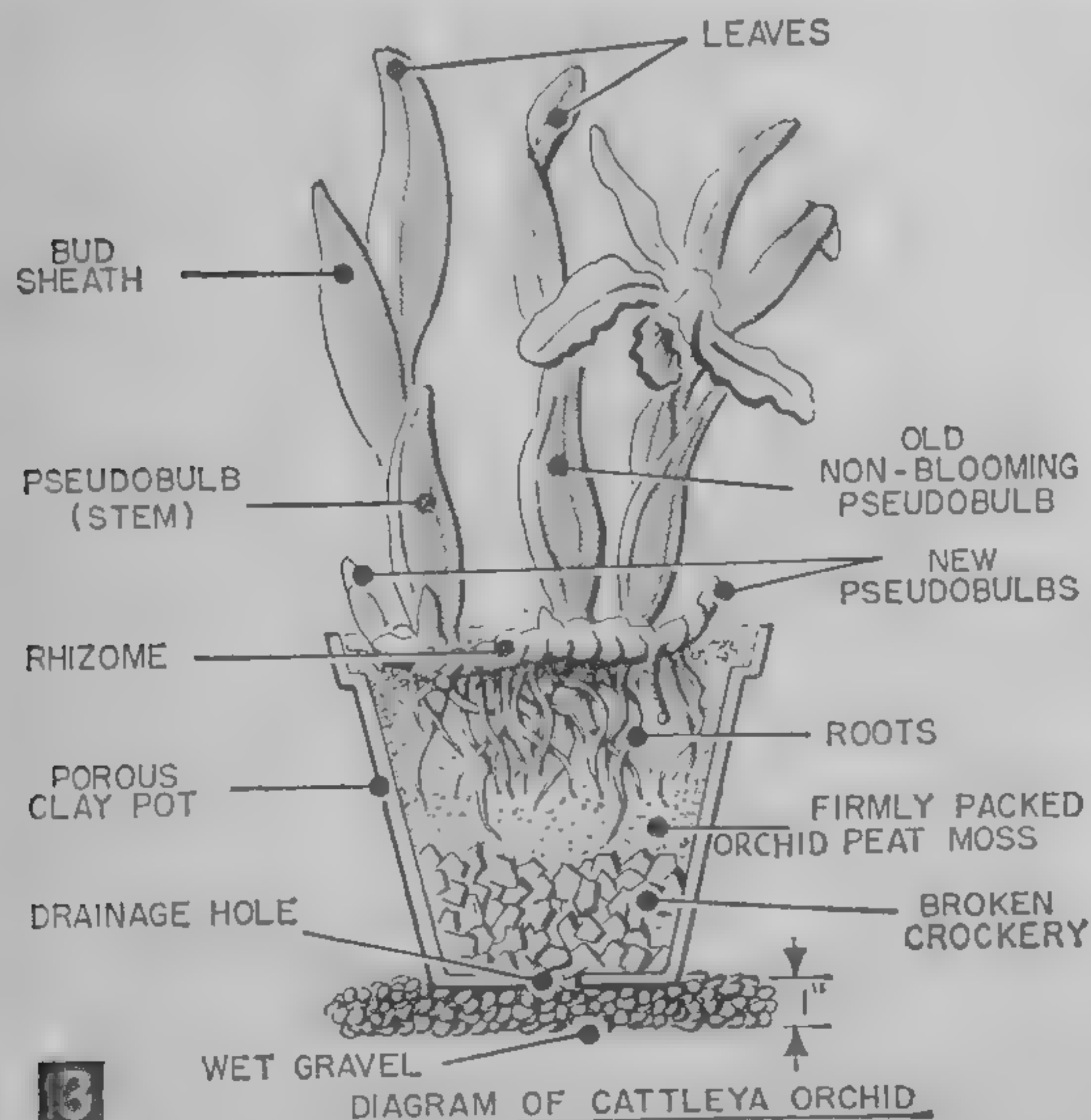


DIAGRAM OF CATTLEYA ORCHID

such as *Miracle Gro* once a month does the plants good.

Place your orchid greenhouse near a window in a partially-shaded section of the house, preferably on a southern exposure. From November 1 to March 1 the plants can be exposed to full sun, but for the balance of the year they should be shaded so they receive only indirect sun. They prefer a temperature of 60 to 65° at night and 75 to 85° during the day. Check the thermometer often and adjust openings in greenhouse accordingly to maintain a constant temperature and humidity.

During winter nights I keep the ventilators and top of my greenhouse closed completely. In the morning I turn the lights on for a while to supplement the sunlight. As the heat in the radiator near which the greenhouse is located comes up, I open the ventilators slightly. In the summer ventilators and top are opened fully but, even with maximum ventilation sufficient humidity is trapped in the greenhouse, due to the water in the pans under the plants.

fortunate as I was to find good plants selling for \$2 to \$5. While seedling plants are less expensive, they take from five to seven years to produce flowers, requiring more patience than most beginners have. The pleasure of watching buds appear and unfold within a relatively short time more than makes up for the added expense of purchasing larger plants. Buy from your local florist or from mail-order firms which carry orchids and other tropical plants.

Place each plant in its own pot, using orchid peat moss (osmunda fiber), *not* soil. Set the pots in a shallow pan or tray filled to a depth of about 1 inch with gravel. Keep the gravel moderately wet to promote a humidity of about 60°, but *never* allow pots to rest in the water. Water the plants twice a week in the winter, three or four times a week in the summer. Be sure they dry completely between waterings. Sponge the leaves occasionally to prevent accumulation of dust and scales. Spray with a mild solution of DDT once a year to control diseases and insects.

There is a difference of opinion among orchid raisers as to whether orchid plants should be fed plant food. I have found, however, that a mild solution of plant food

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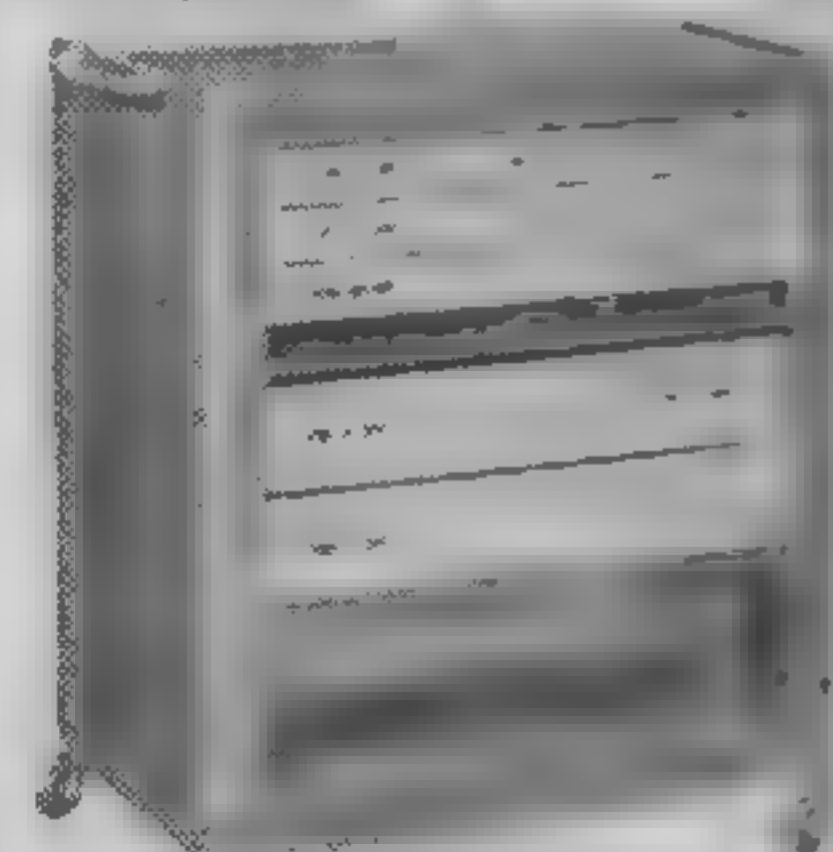
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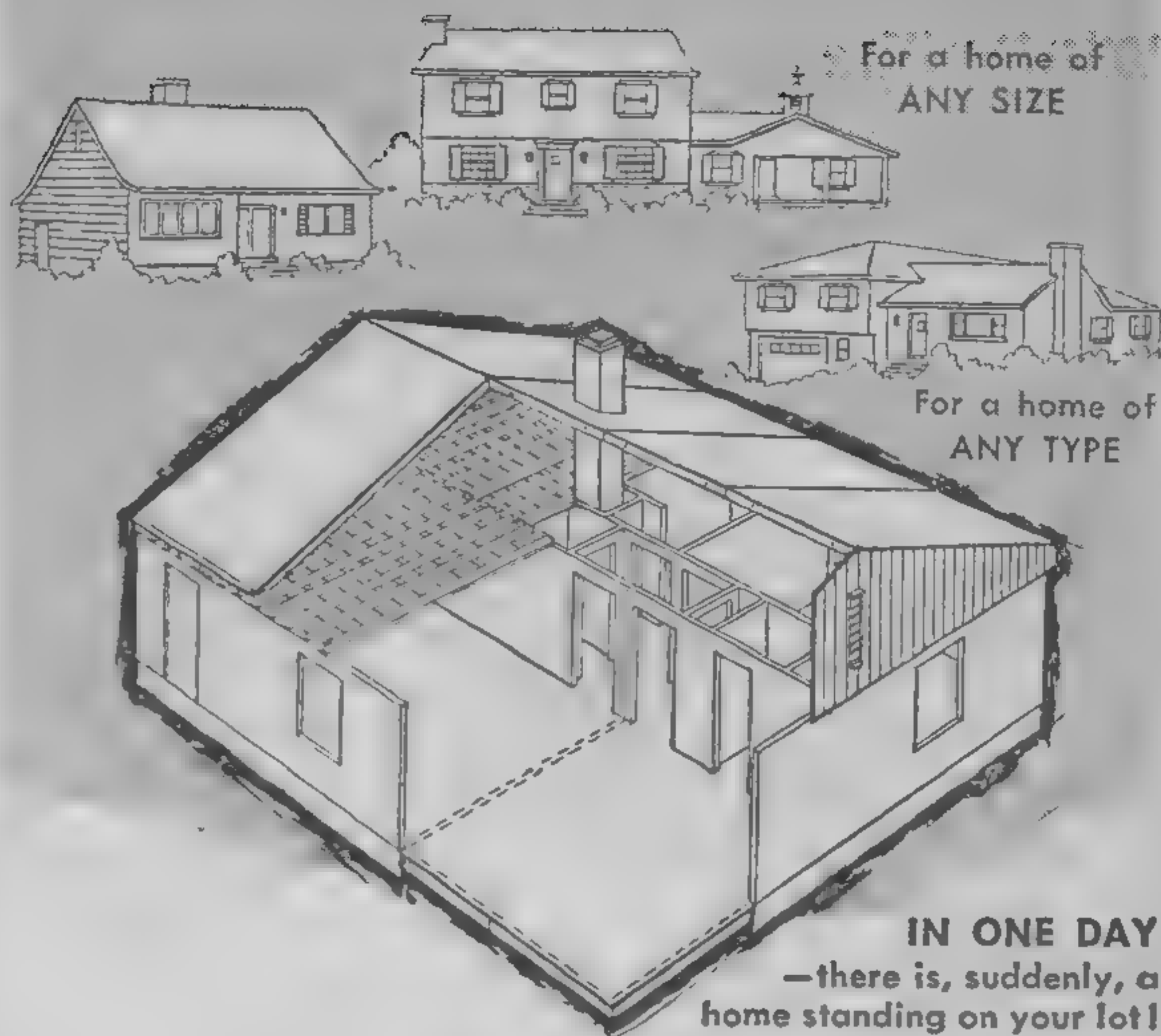
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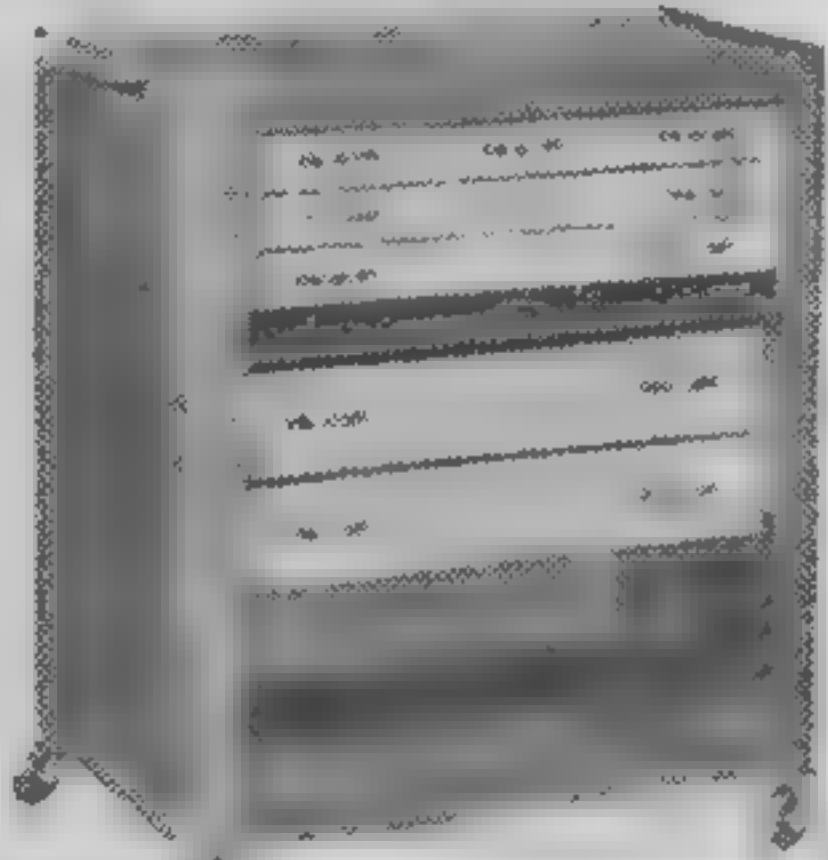
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Flowers form only on new growth rising from eyes in the rhizome (Fig. 3). When the leaf attains full size, a sheath or pod appears at junction of leaf and stem or pseudobulb. The flower starts forming when the pod is a few inches long. After the pod has split to permit the bud to extend beyond it, it is only a matter of one or two weeks until the flower opens up. Since the entire process requires about a year, each flower will give you a real sense of accomplishment.

If a plant appears very crowded in its pot, it may be repotted after blooming. Remove the plant very carefully from its pot and clean all the osmunda from the roots. Fill a larger pot one-third full with pieces of the old pot or other crockery for drainage purposes, and insert plant in the new pot, completely caulking with small chunks of orchid osmunda until the

compost is very firm. The handle end of a mop or old broom can be used as a caulking tool, but be careful not to injure the roots. Since new growth develops at the front of the plant, place the back of plant (or oldest growth) rather close to side of pot to allow plenty of room for future growth.

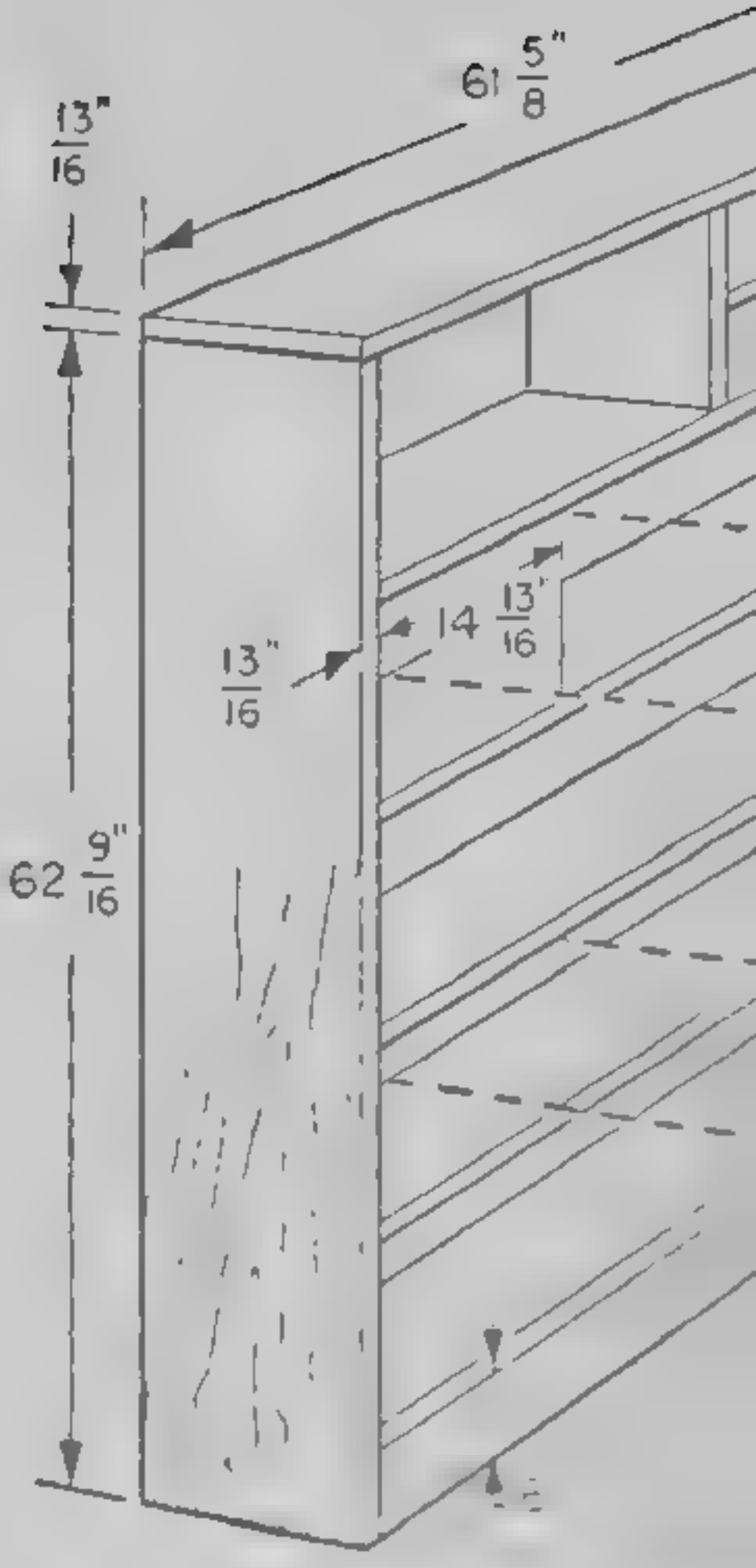
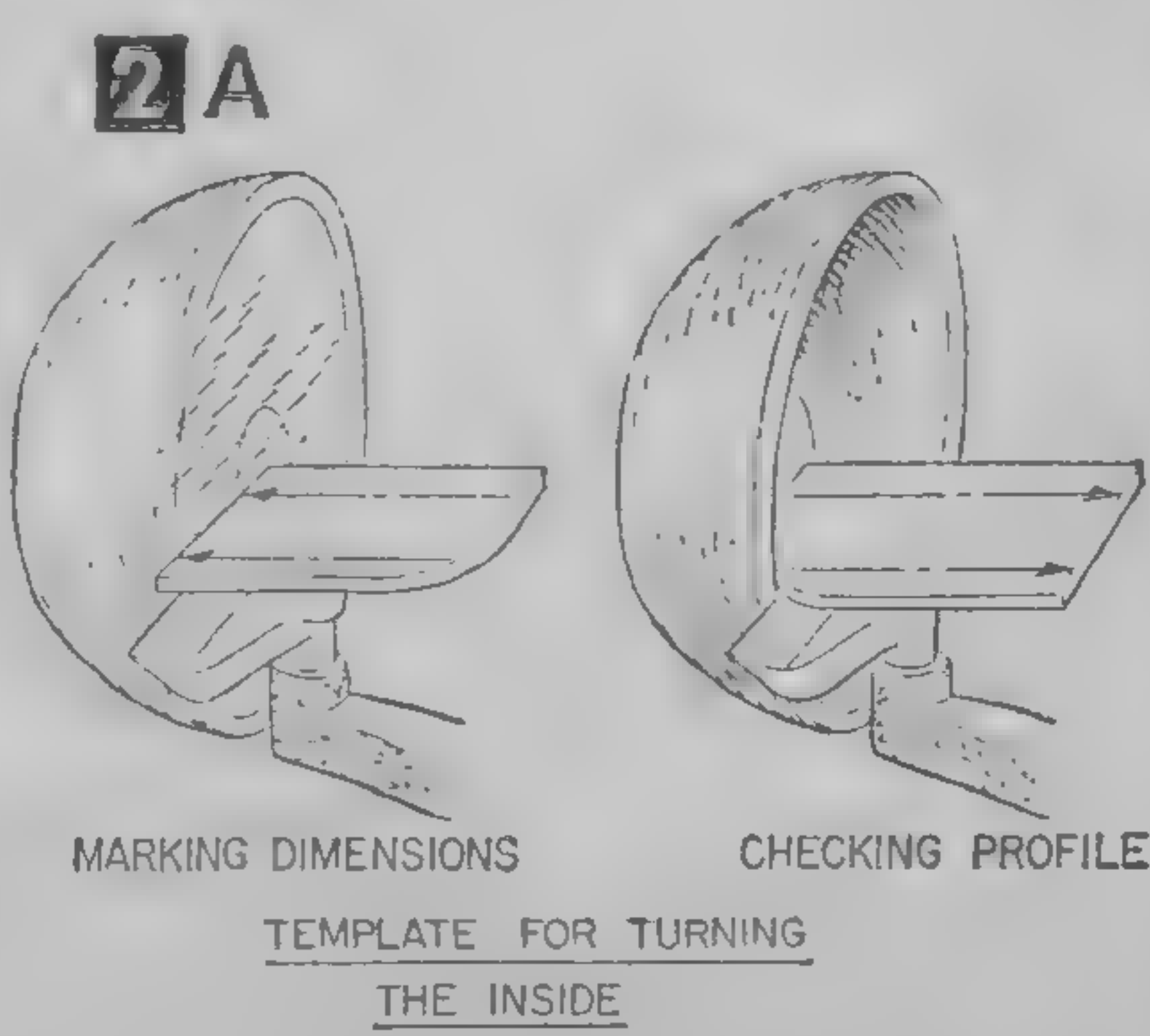
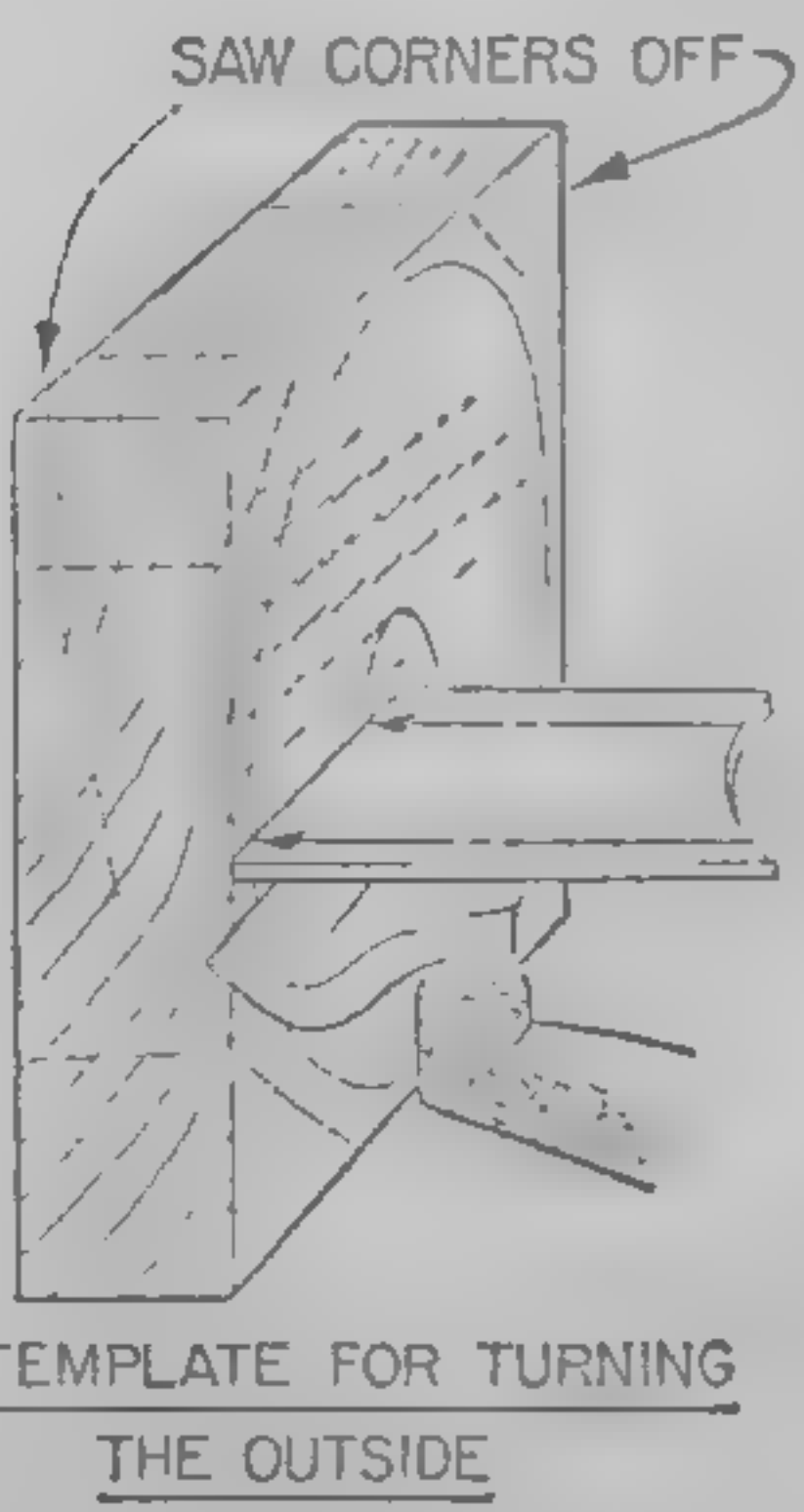
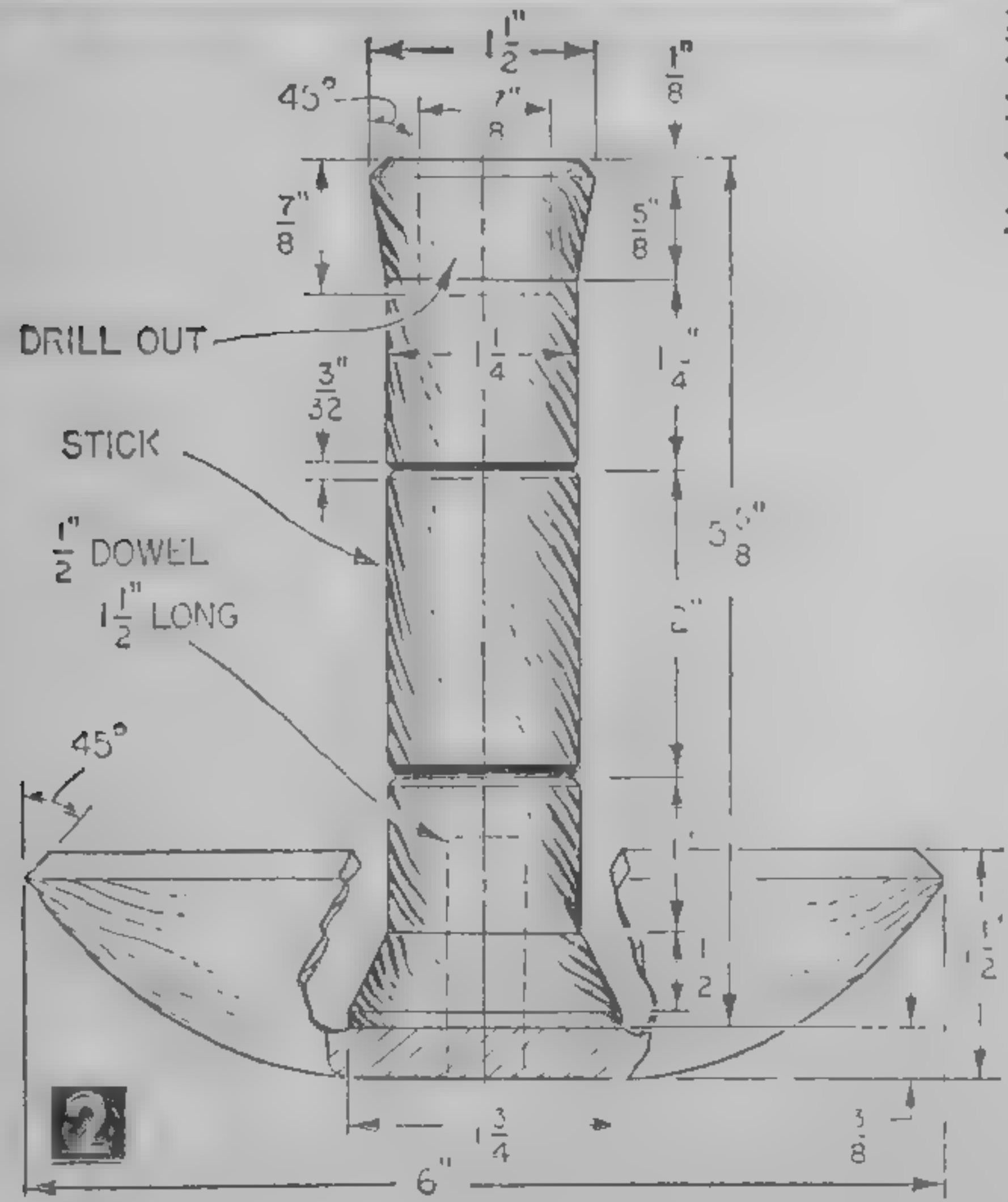
As you gain experience in raising orchids, try some of the other hardy species, such as epidendrum, cyripedium (lady's slipper), phalaenopsis dendrobium and oncidium. Or raise new orchid plants from seedlings, divisions or even seeds. You can also use your greenhouse for any plant that can be normally grown in a terrarium—for example, African violets, Baby's Tears, begonia, caladiums, crotons, English ivy (miniature), ferns and wandering Jew. I now have some Bird-of-Paradise plants in my greenhouse, and they are developing new shoots.

Quaint Candle Holder

By NORBERT ENGELS

THIS candle holder can be used as in Fig. 1, or, as a hurricane lamp with the addition of an old-fashioned lamp chimney.

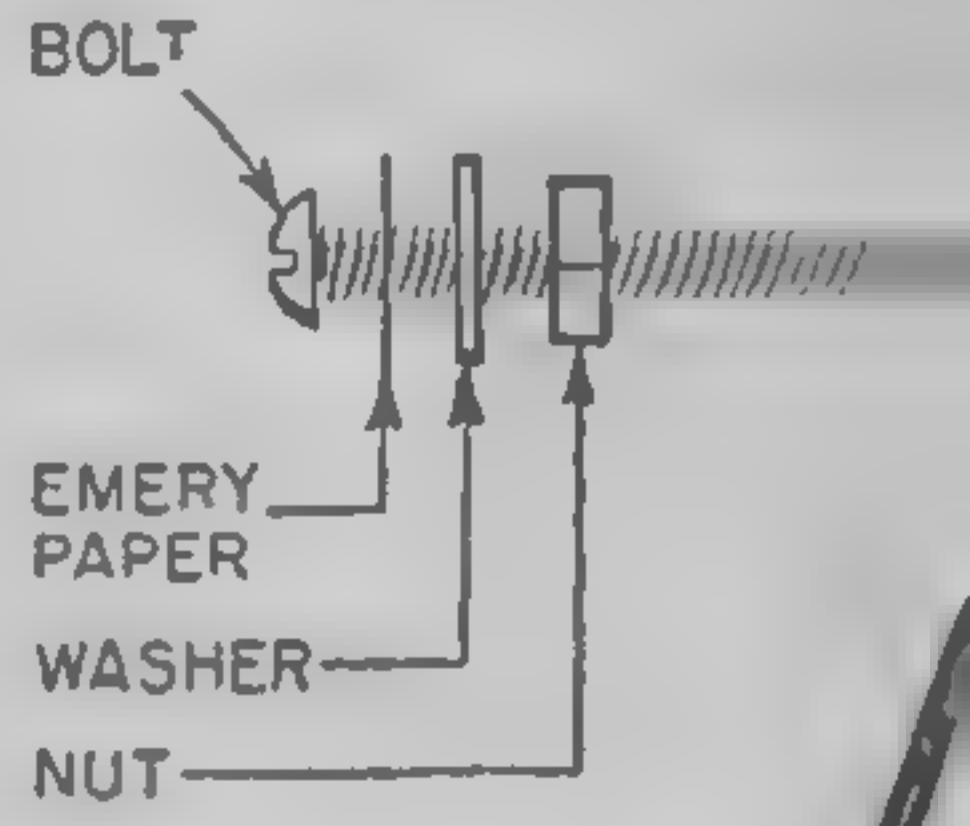
Turn the stick portion (Fig. 2) and drill the top end for a candle and the bottom for a dowel. You may use a commercially available wooden salad bowl for the lower portion. Or, make your own on a lathe by mounting a 2 x 6 x 6-in. block (reduced to octagonal form by cutting the corners off) on the lathe faceplate. Prepare a template as in Fig. 2A. Shape the outside first, using a narrow skew chisel to true the edges, then a scraping tool. To hollow out the bowl, remove, turn the block over and remount it on the faceplate. Then mark the edge of the disc as in Fig. 2A, and hollow out with a gouge, starting at the center of the disc, working toward the outside edge. Roll the blade in the direction of motion. Finish by scraping with a skew, square-nose or spear-point. Bevel the edge to a 45° angle, and drill the dowel hole in the bottom. Sand the parts, then assemble, glue-coating mating surfaces. When dry, stain. Follow with two coats of varnish, lightly sanding between coats. Wax, then vigorously rub to a gloss.



EVER wonder what books that simply bookshelves? Such that, even if there we end, they would sag tion is a simple shel bookcase which perm flat in handy stacks of with a minimum of wa also increases rind assembly and helps made for bookcases built into new ones. Make a 30-in. shelf

Re-Seating

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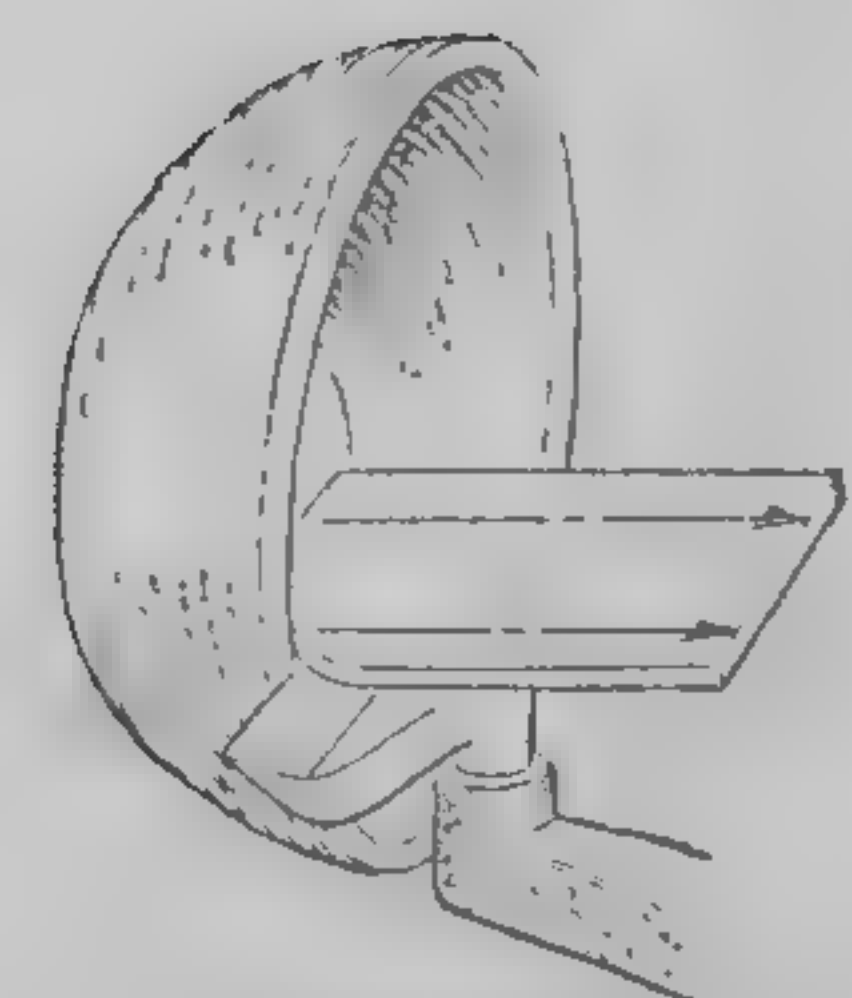
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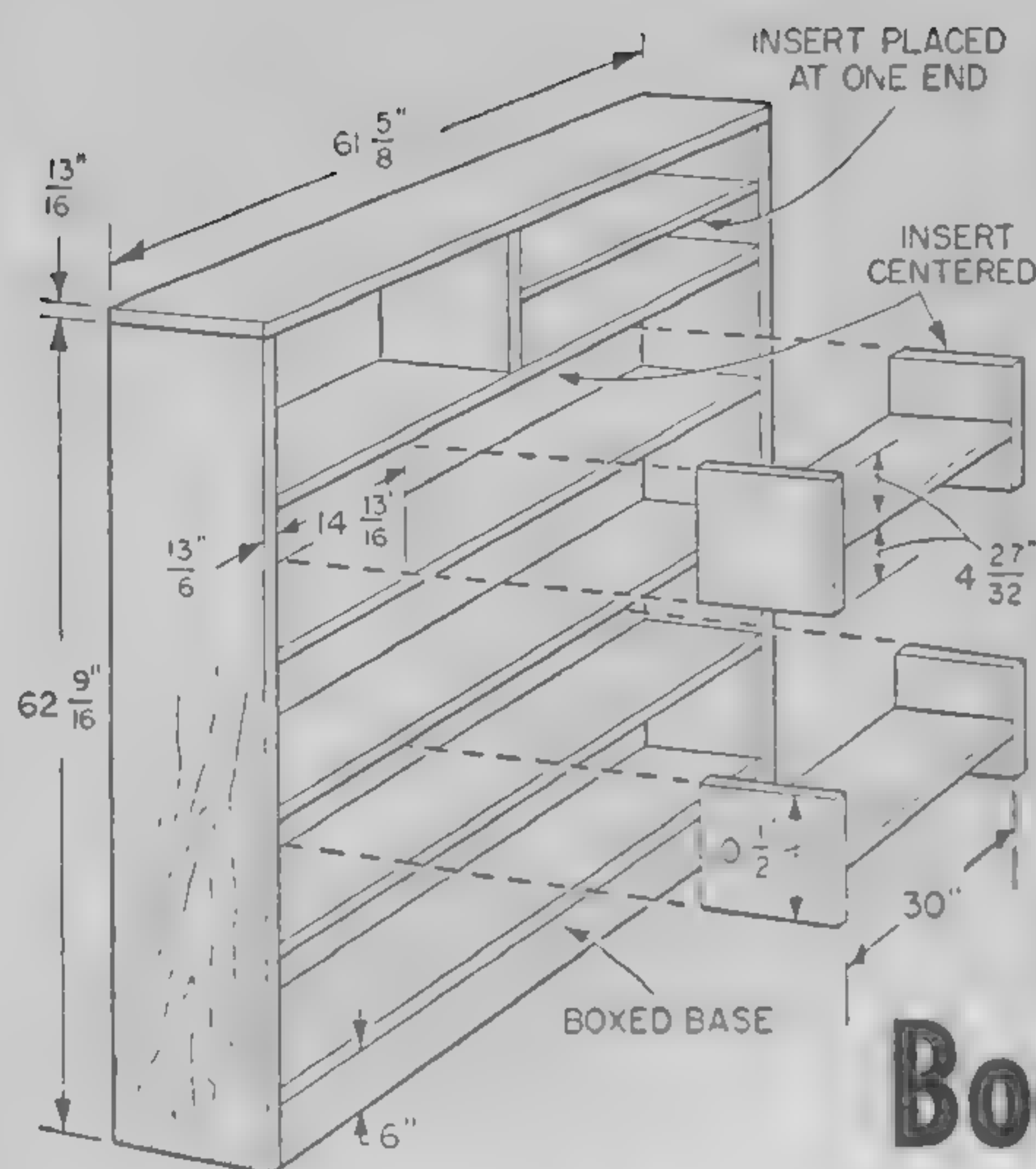
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CHECKING PROFILE
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CE AND MECHANICS



Bookcase Shelf Insert

EVER wonder what to do with those oversize books that simply do not fit into conventional bookshelves? Such books usually are so heavy that, even if there were room to stand them on end, they would sag out of shape. An ideal solution is a simple shelf inserted in a regulation bookcase which permits large books to be laid flat in handy stacks of two to four volumes each, with a minimum of wasted shelf space. The insert also increases rigidity of the over-all bookshelf assembly and helps prevent shelf sag. It may be made for bookcases already in use or may be built into new ones.

Make a 30-in. shelf insert for bookcases at least

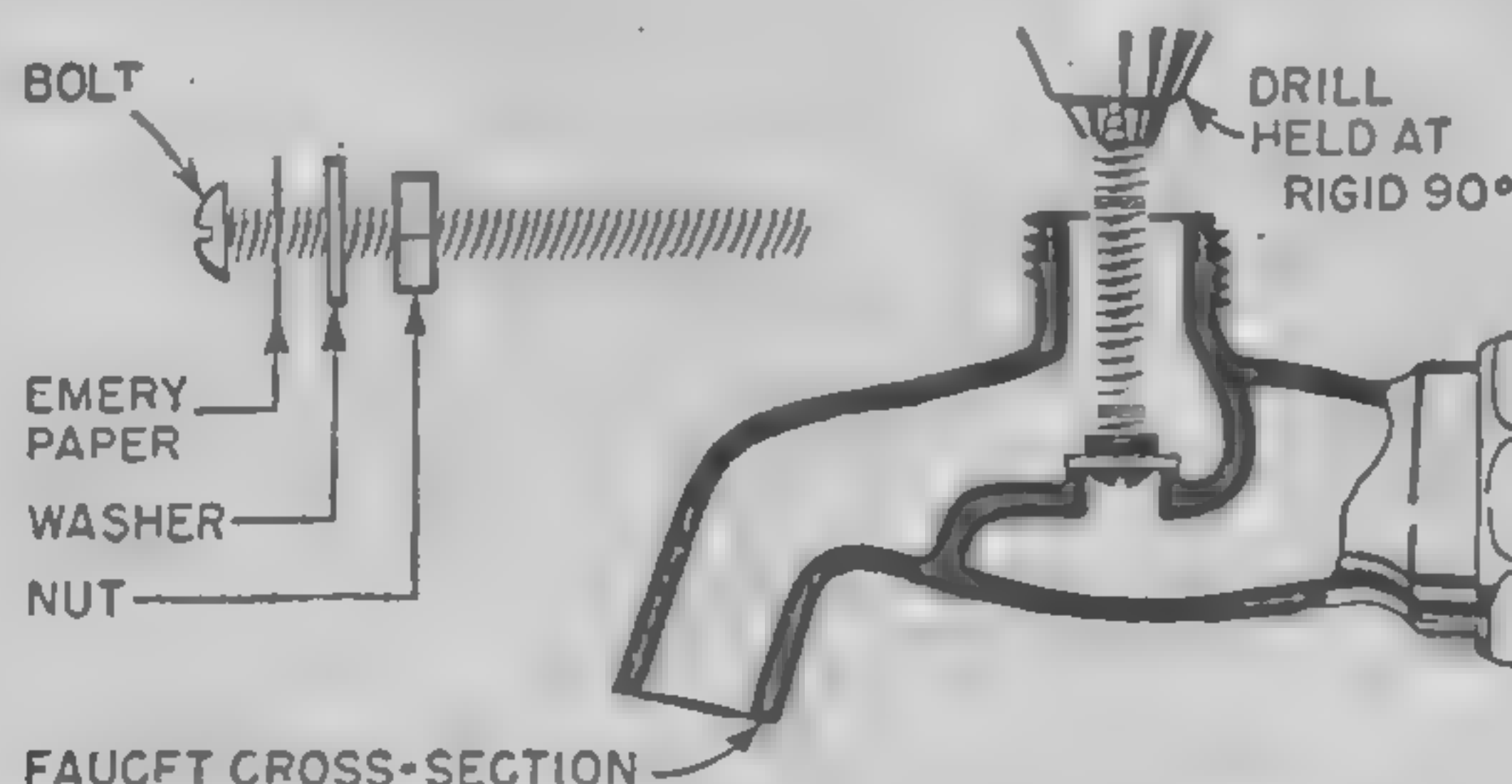
4 ft. wide, less for a smaller bookcase. Cut shelf to proper length and same width as bookcase shelves, and two end pieces to same width and high enough to stand snugly between two of the bookcase shelves.

Sand shelf and end pieces smooth and finish to match bookcase, then assemble with No. 6 2-in. finishing nails. Place the shelf insert in bookcase, square the ends vertically with the horizontal shelf surfaces. Secure with No. 6 finishing nails.

If bookshelf is 5 ft. or more wide, center insert; if much less than 5 ft., place it at one end of the bookcase, in which case one end piece of insert can be eliminated.—ALAN McLEOD.

Re-Seating Leaky Faucet

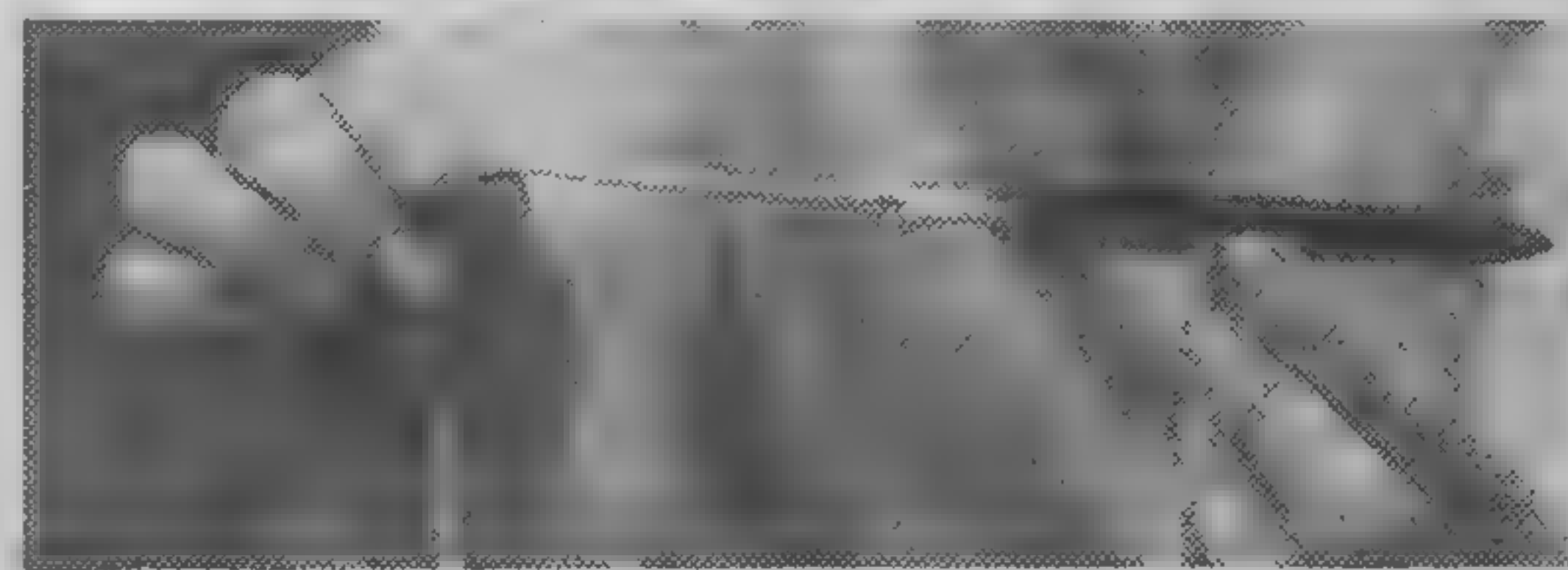
• When re-seating water faucets in the home, a simple bolt assembly may be used to avoid the expense of purchasing a seat reamer. On a long stove bolt fit a disc of emery paper cut to washer size, a washer and a nut as shown in sketch. Place assembled stove bolt in a hand drill and



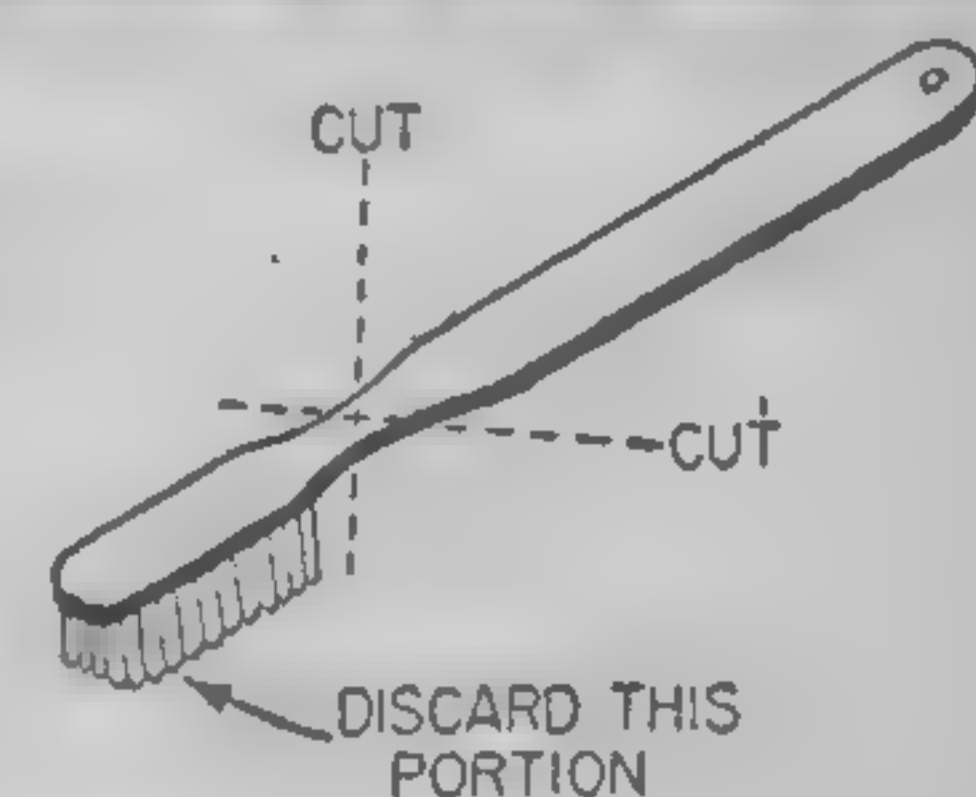
allow to rest lightly on the valve seat of the faucet. Hold drill vertically and turn to smooth surface of rough valve seat. Faucet will not leak and will not wear out the rubber washer as quickly.

If different types of faucets are encountered in the home, merely substitute a different-sized washer and emery paper to fit each faucet-seat.—DANIEL J. PRY.

Toothbrush Handle Strings Along



• The handle of a discarded toothbrush containing a hole for hanging makes a handy tool for threading a drawstring or ribbon through a laundry or duffle bag and clothing, and may even be used as a fish stringer. Cut handle off at the narrowest point, sand and then buff to a smooth finish.—A. ZANELLI.

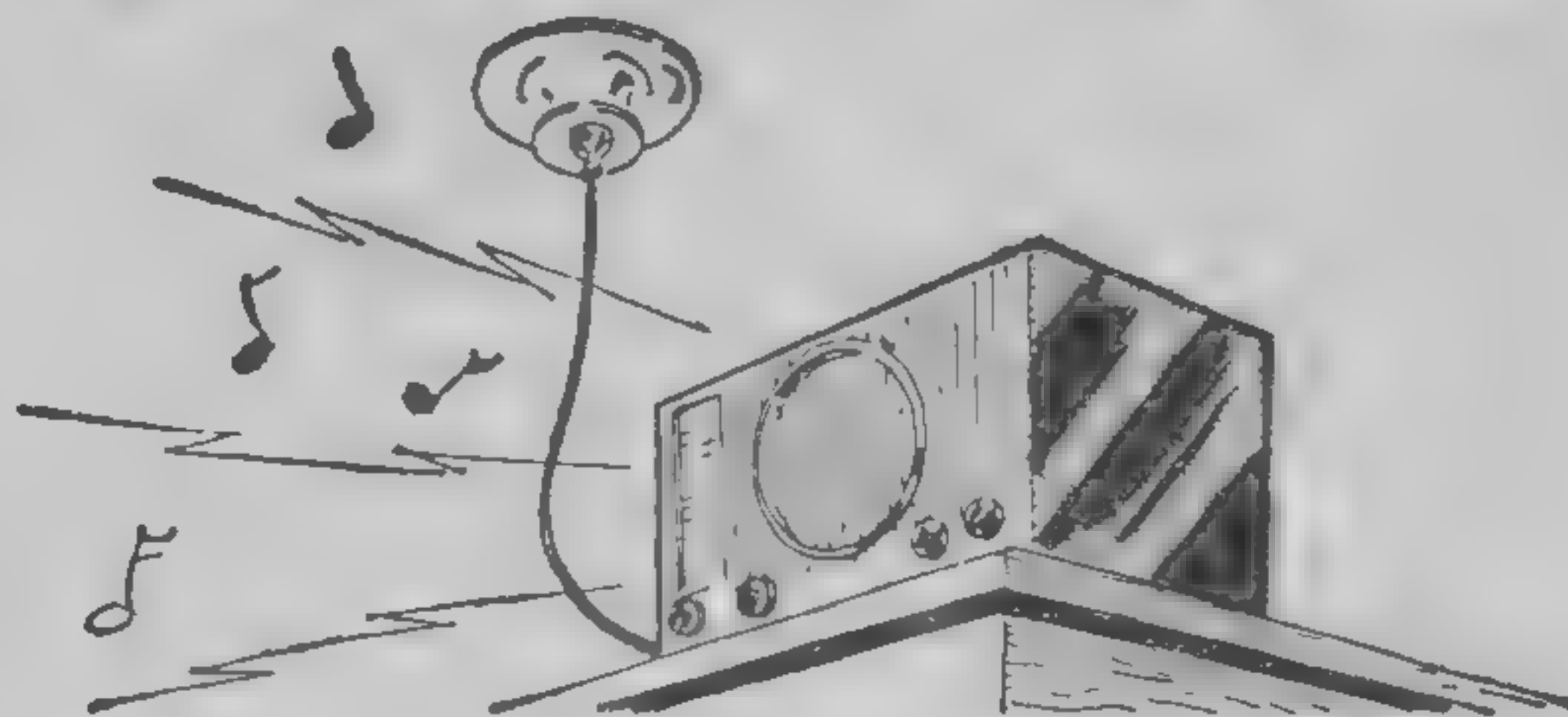


Garbage Can Identification

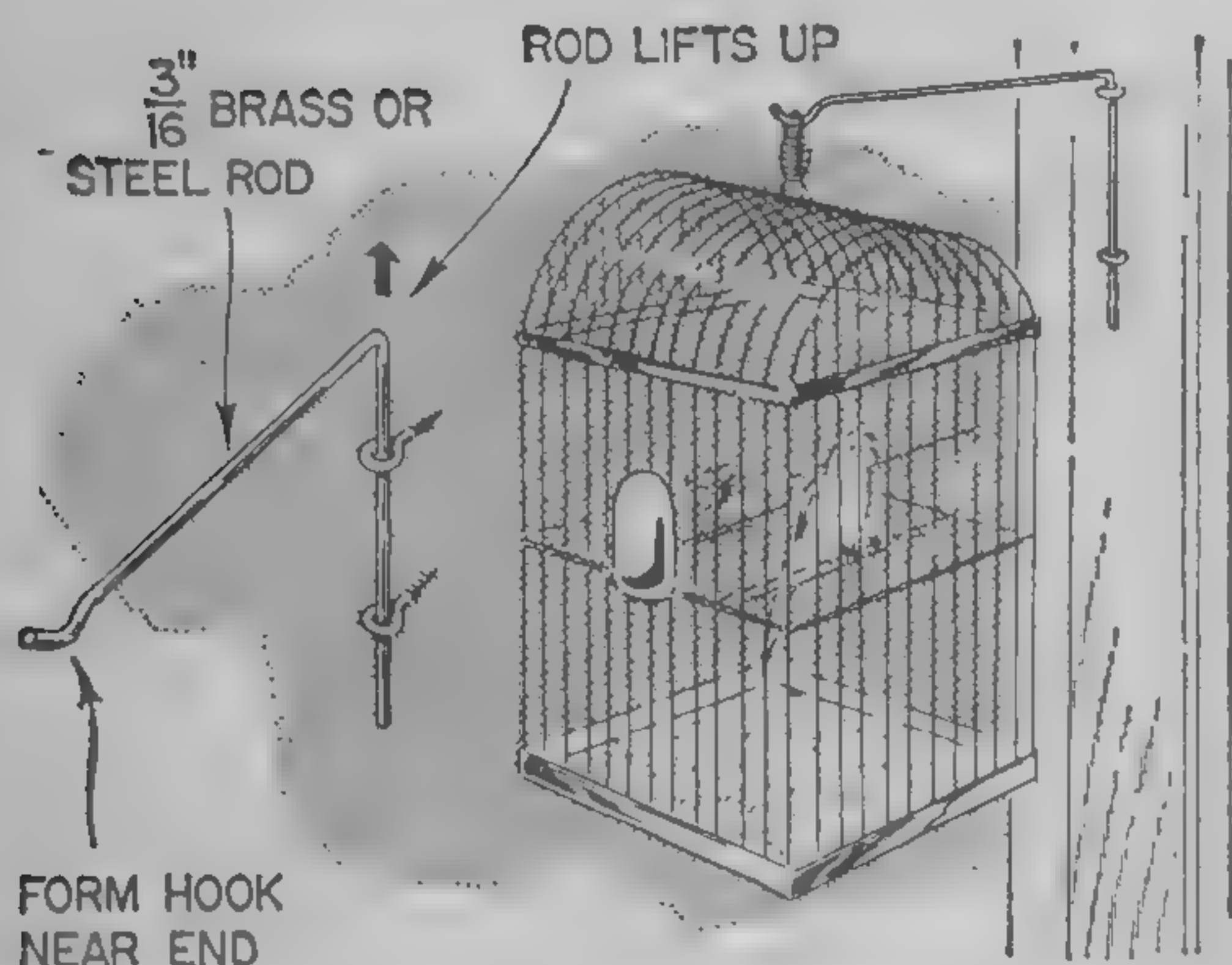
• Paint your house number on garbage and ash cans to reduce the chances of the cans being lost or stolen. Galvanized steel cans should first be wiped with a cloth dampened in half-and-half mixture of vinegar and water, so that paint will adhere.—L. SCHUMACHER.



Ideas For



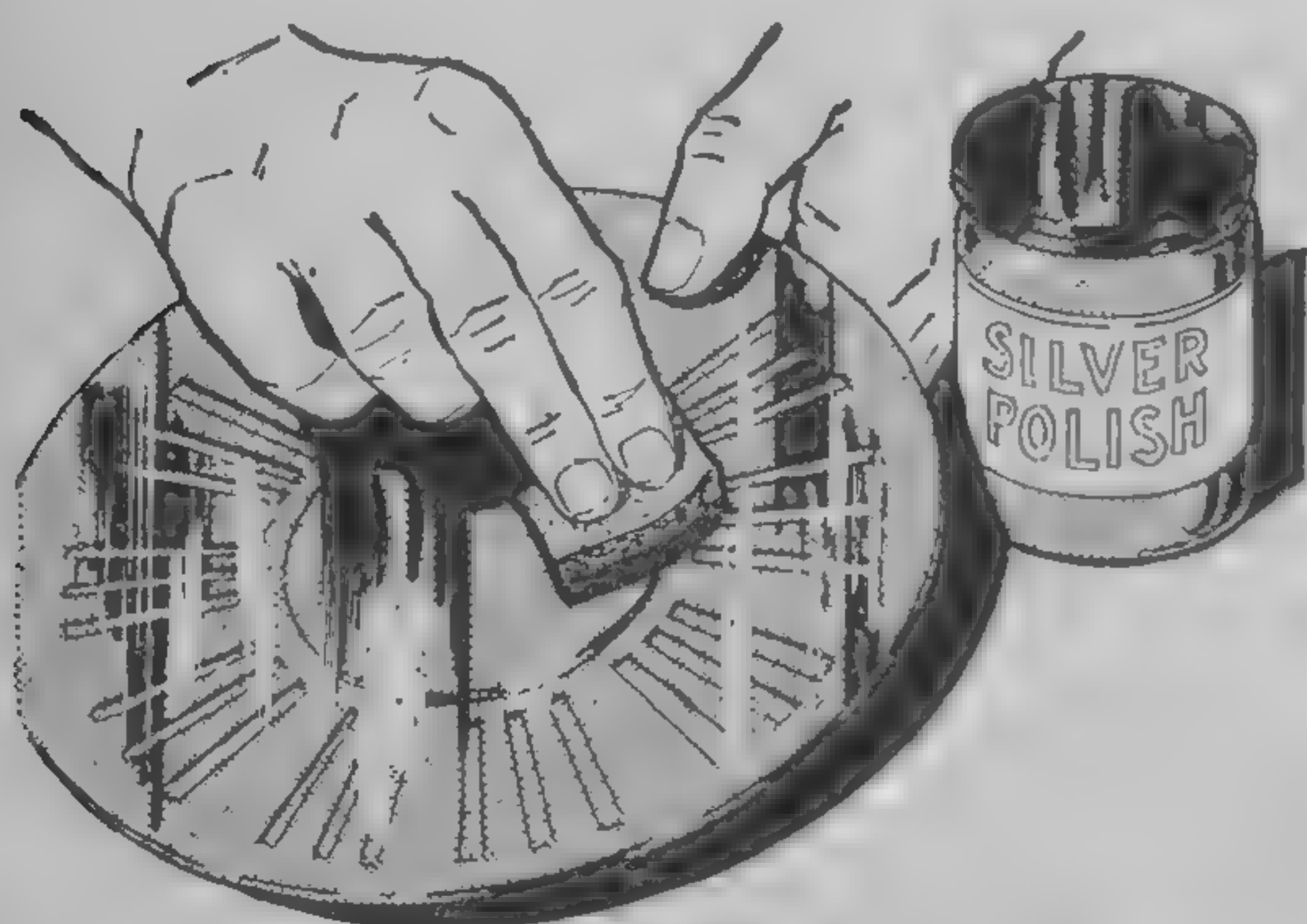
Keep a permanent record of the household electrical circuitry to prevent confusion and loss of time during power failure. Identify circuits safeguarded by each fuse by connecting a radio to outlets and fixtures, in turn. With volume turned up, remove fuses or trip circuit breaker switches until the radio goes off. Record near the fuse or circuit breaker cabinet the outlets and fixtures in each line.



A removable and pivotable hanger bracket for planter or bird cage is easily made from rod bent as at left above. Fasten two screw eyes to door or window frame. Drill starting holes no smaller in root diameter than screw eyes, soap latter to prevent splitting wood. Slip the rod through the screw eyes.



If a grommet-type snap clothes fastener, such as found in work clothes or undergarments, no longer holds it own, the small split flanges inside the fastener are probably spread too far apart. Remedy by gripping each flange in turn with tweezers and bend slightly inward.

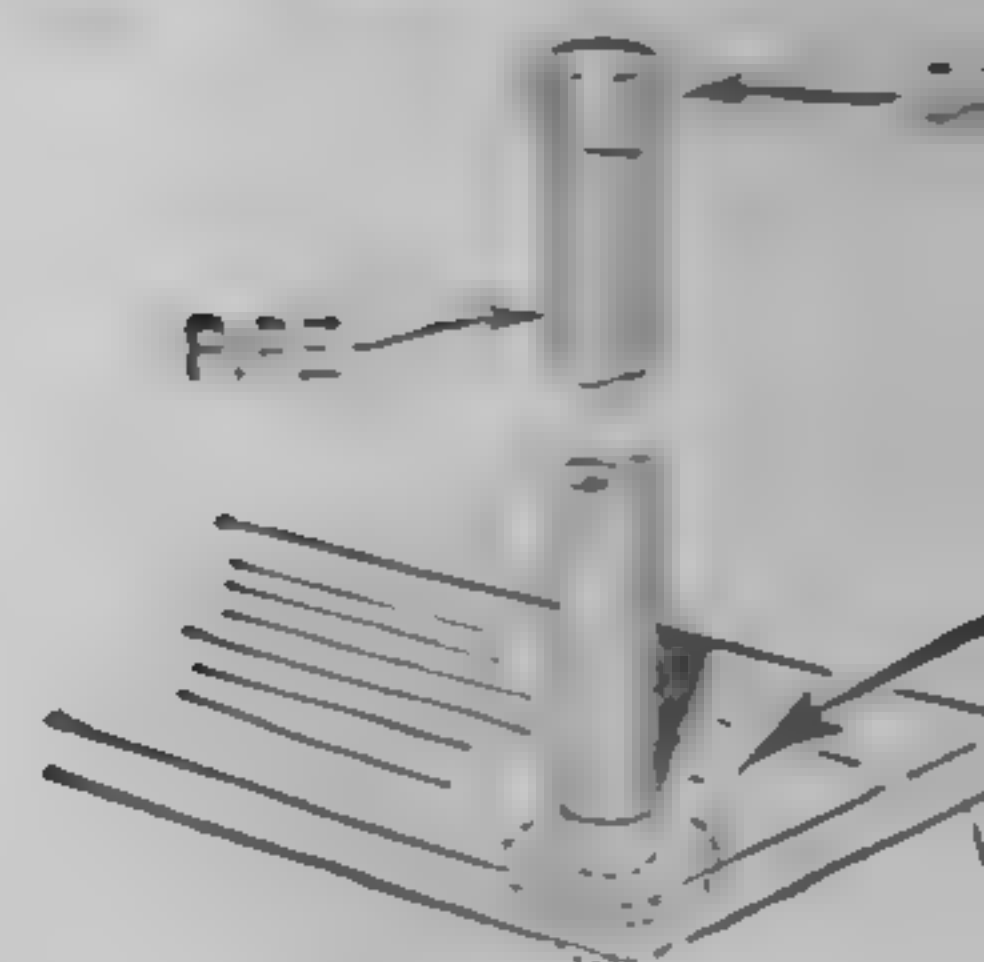


Make your own low-cost polishing pad by saturating a $\frac{1}{4} \times 1\frac{1}{4} \times 1\frac{1}{2}$ -in. piece of felt with any good commercial silver polish. Let dry, then use to dry polish silver, brass or other metal. Keep pad in covered jar.

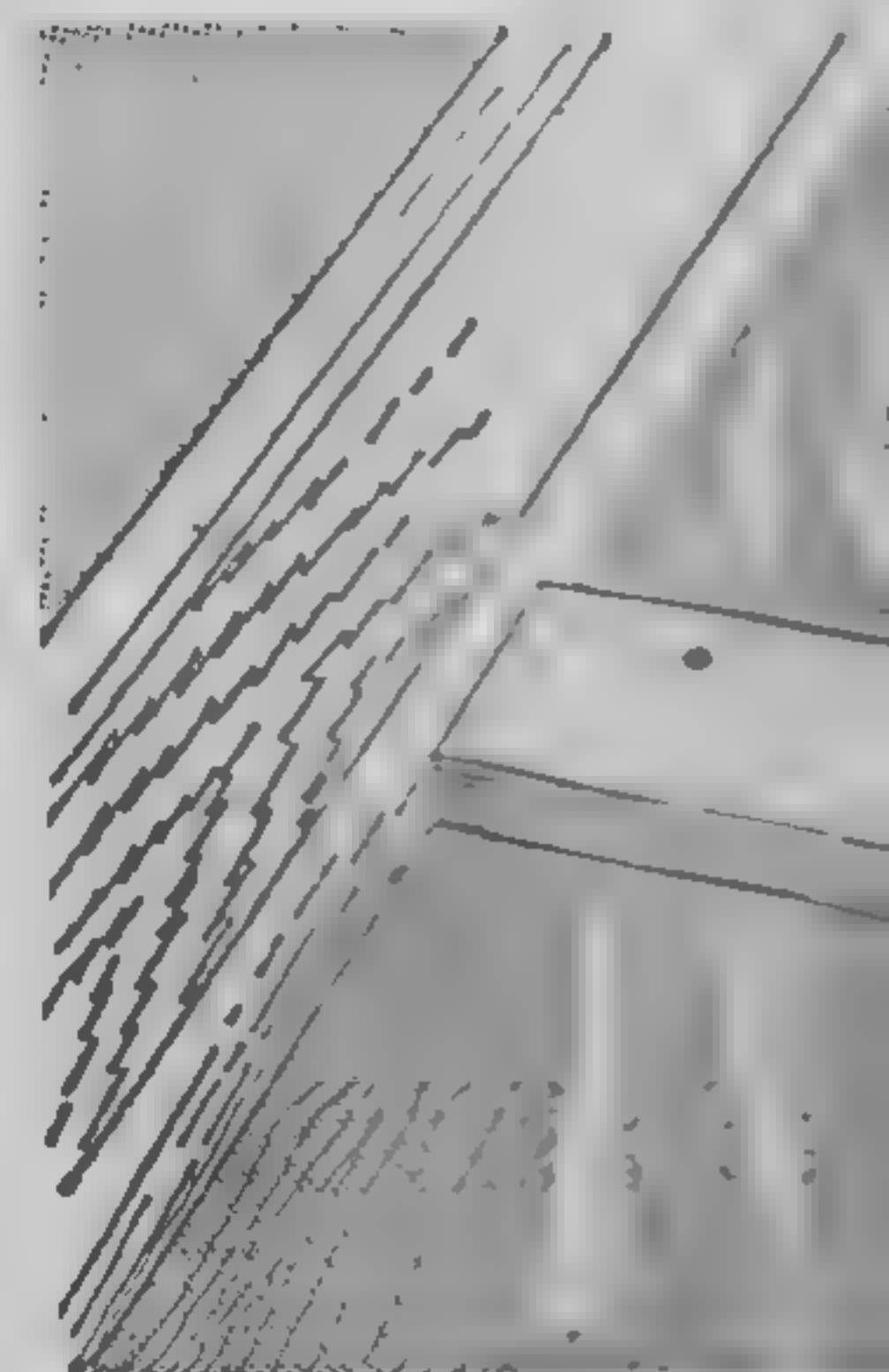


When you have finished a needlepoint or woven top for your chair, shellac it on the back before putting it on the stool to increase its durability.

Your



This attachment will help while working from one step ladder. First bore a ladder of the proper diameter of $\frac{3}{4}$ -in. pipe threaded at of the step, screw an insert the pipe from the top. Cap the other



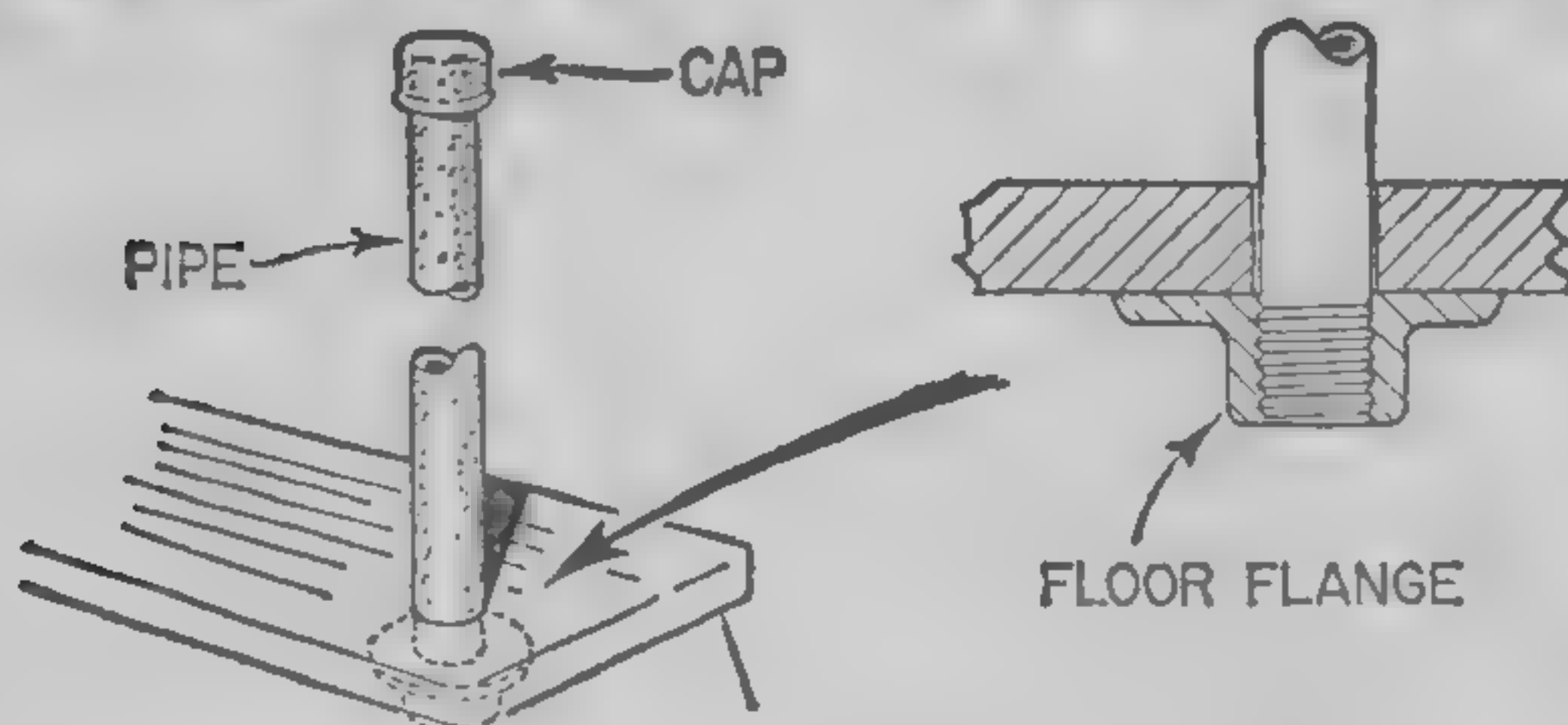
To anchor that slide-away of wood on the floor and resting against the wall sofa legs. Drill holes through the leg. Shellac or varnish. Replace the sofa, if



Use plastic egg container. Affix identifying tab with toothpick with a

For

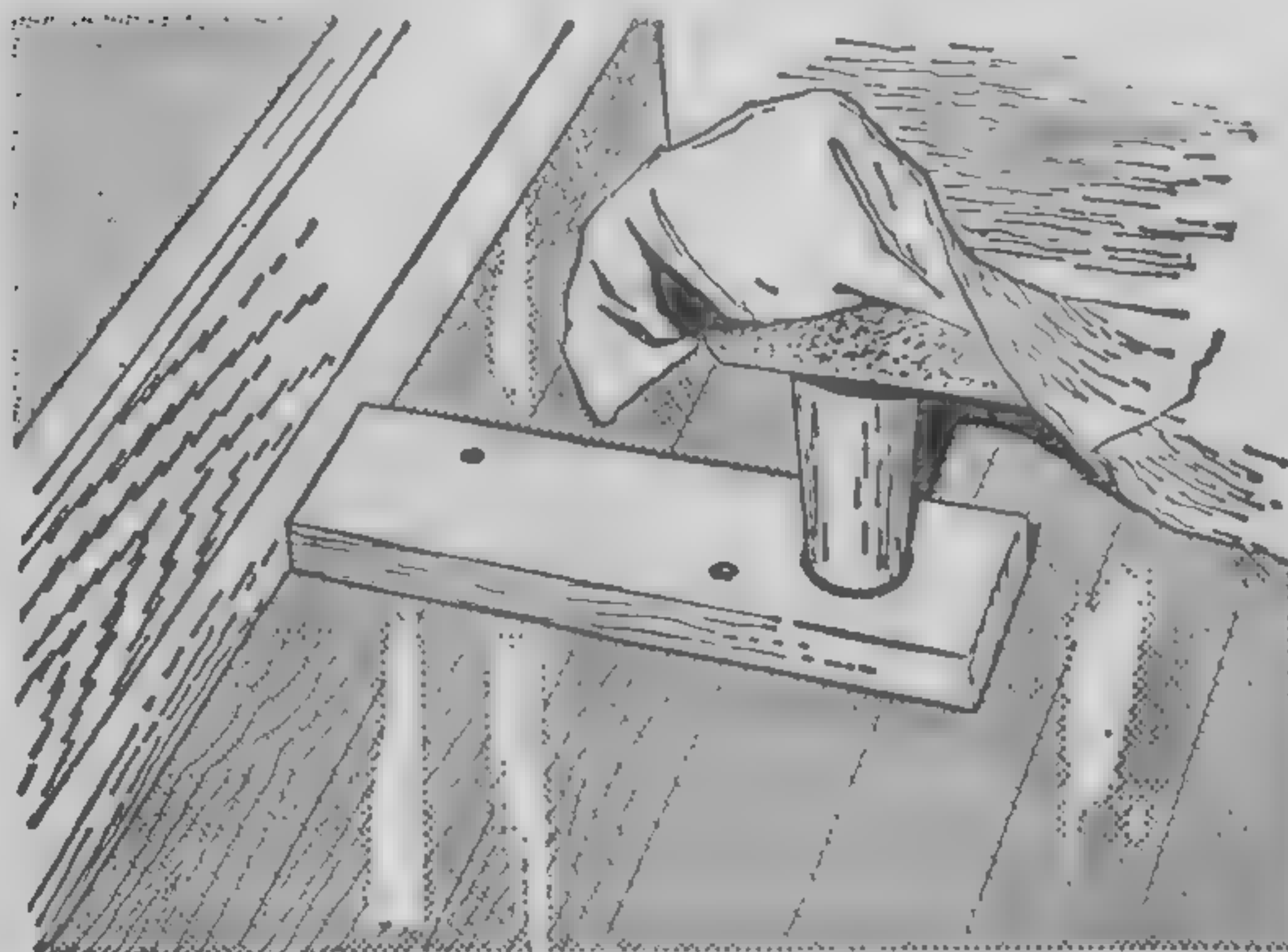
Your Home



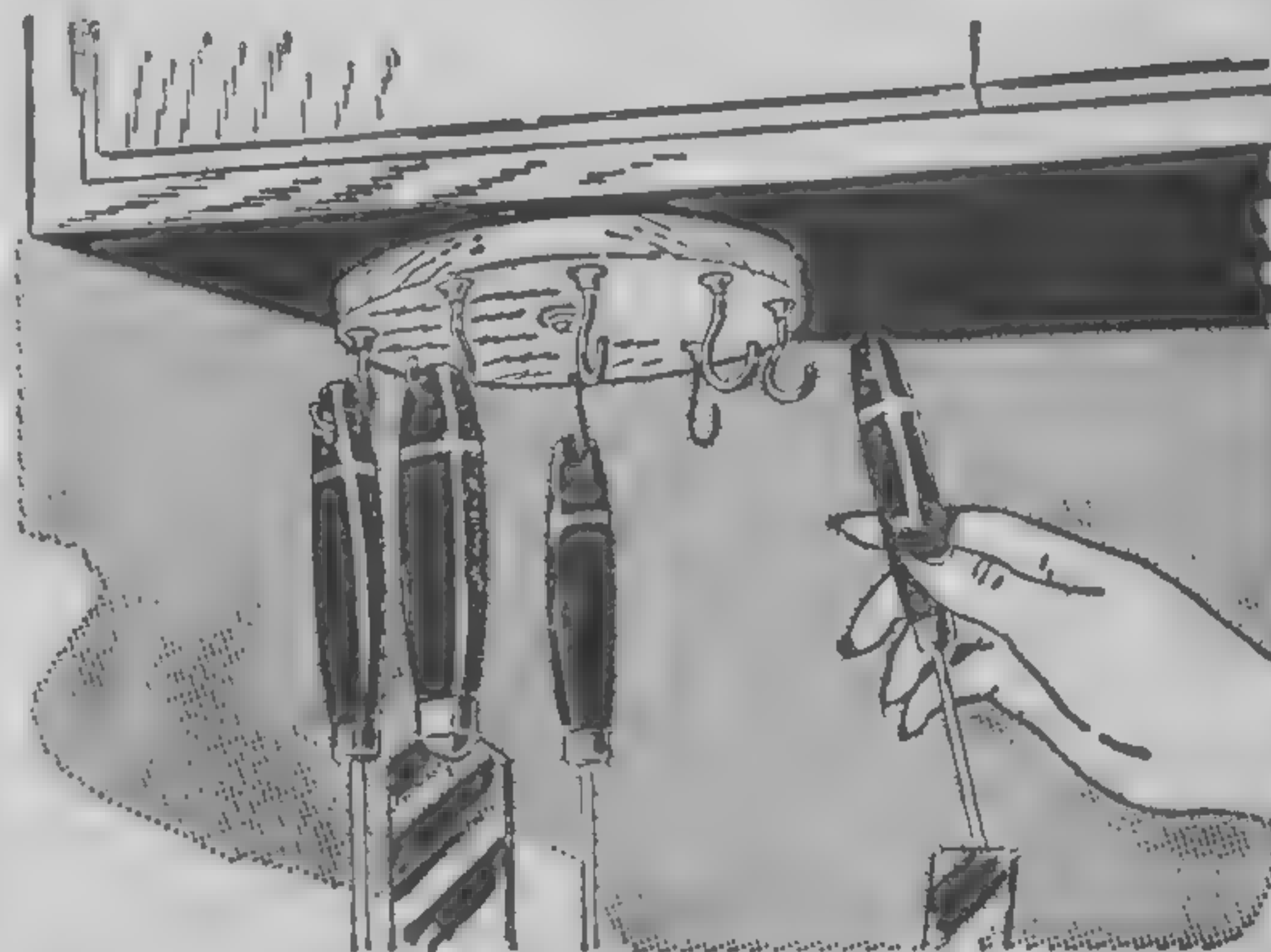
This attachment will help you maintain your balance while working from one of the higher steps of your step ladder. First bore a hole in the top step of the ladder of the proper diameter to receive a length of $\frac{3}{4}$ -in. pipe threaded at each end. To the underside of the step, screw an inverted floor flange. Now insert the pipe from the top and screw-fasten in place. Cap the other end of the pipe.



household electrical loss of time during safeguarded by each outlets and fixtures, in move fuses or trip the radio goes off. breaker cabinet the each line.

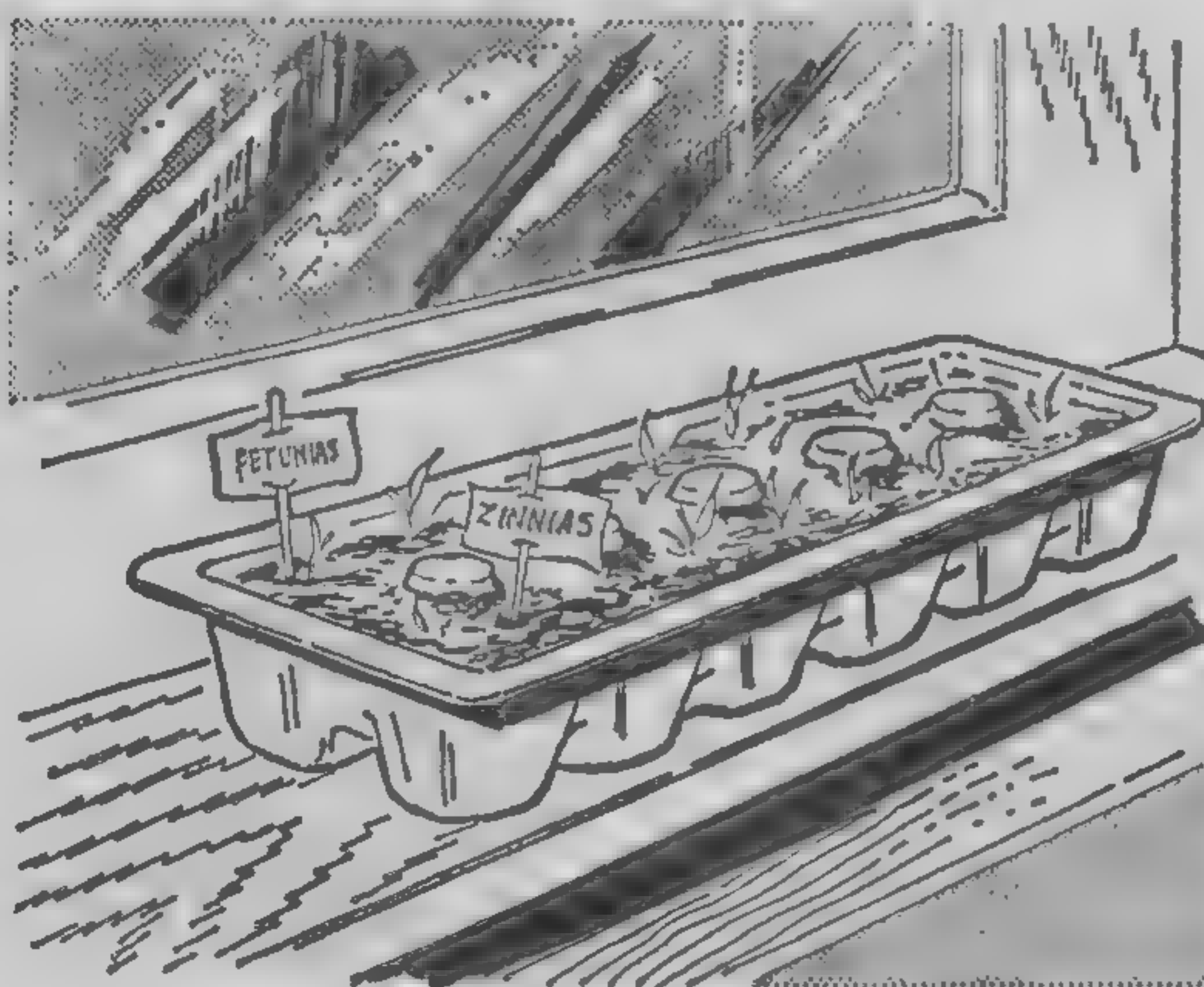


To anchor that slide-around sofa lay a 2-in. wide strip of wood on the floor at each rear sofa leg, one end resting against the wall, and mark the location of the sofa legs. Drill holes through strips to accommodate the leg. Shellac or varnish strip, then tack to the floor. Replace the sofa, putting the leg in the hole.



Keep kitchen and other tools handy under kitchen cabinet or shelf on a lazy-Susan rack that takes up a total space of only a few square inches. Cut disc from wood or plywood, fit one side with eight oversized cup hooks and screw in place with one long bolt and washers.

fastener, such as armments, no longer es inside the fast- apart. Remedy by tweezers and bend



Use plastic egg containers for your plant starter beds. Affix identifying tab with cellophane tape or use a toothpick with a paper flag as shown.



To tighten a loose wooden hammer handle securely in its socket, rub the top end of the handle with a mixture of glycerin and water. This swells the wood, keeping head on indefinitely.



point or woven top back before putting its durability.

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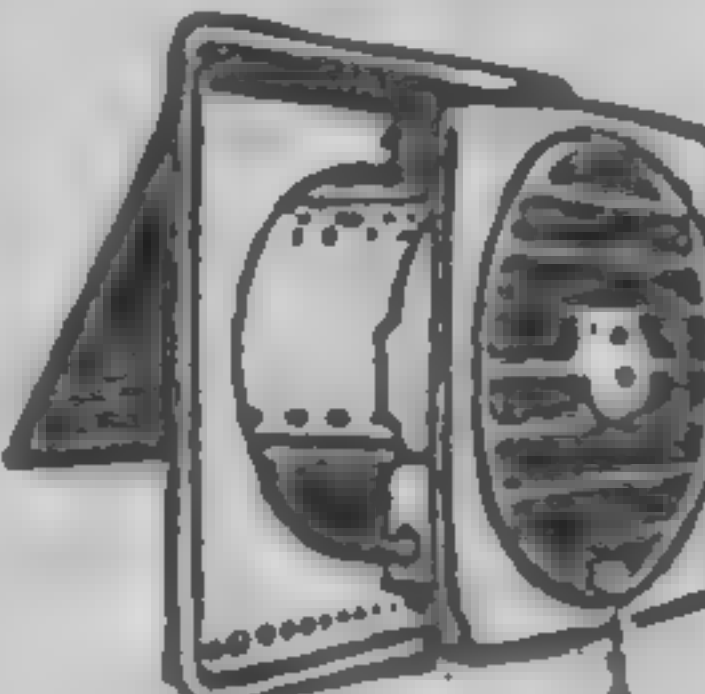
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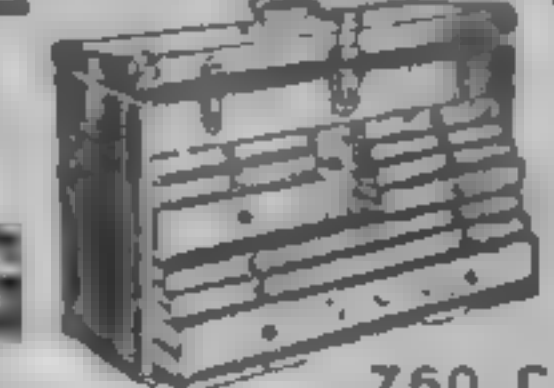
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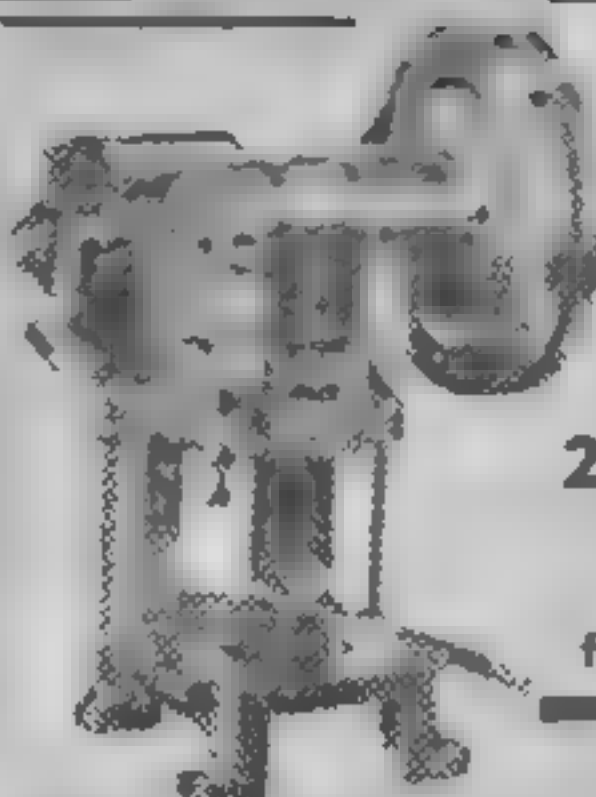
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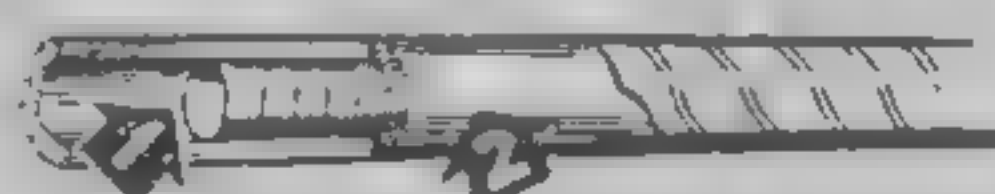
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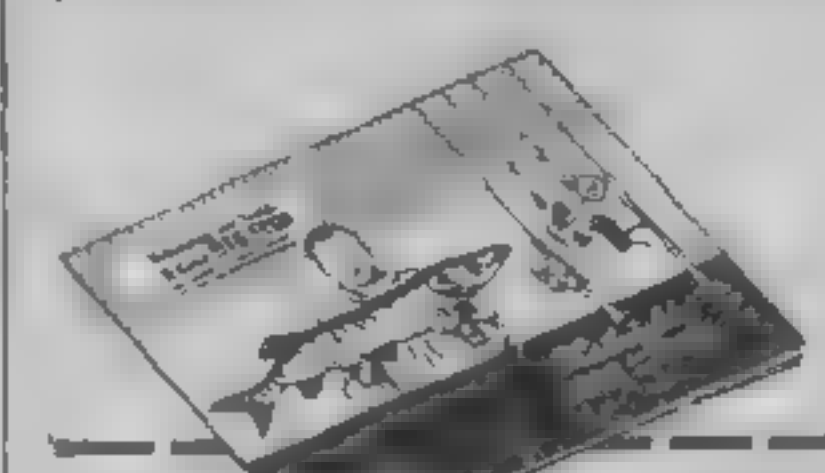
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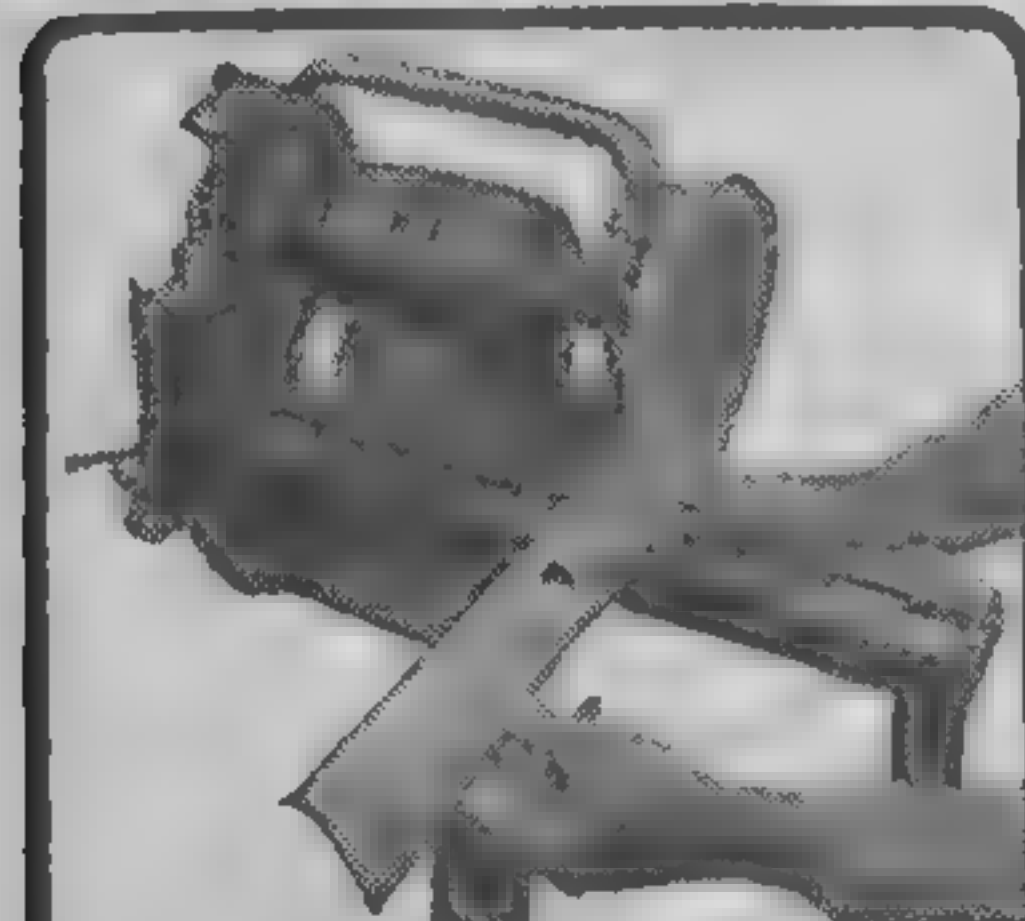
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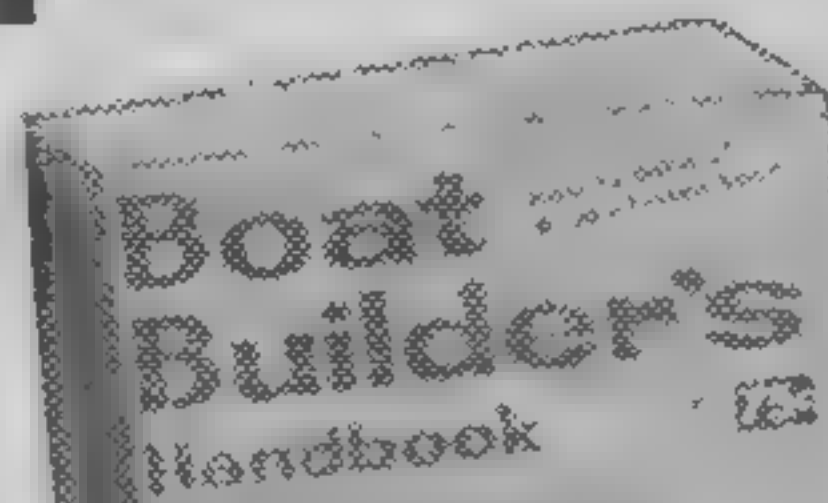


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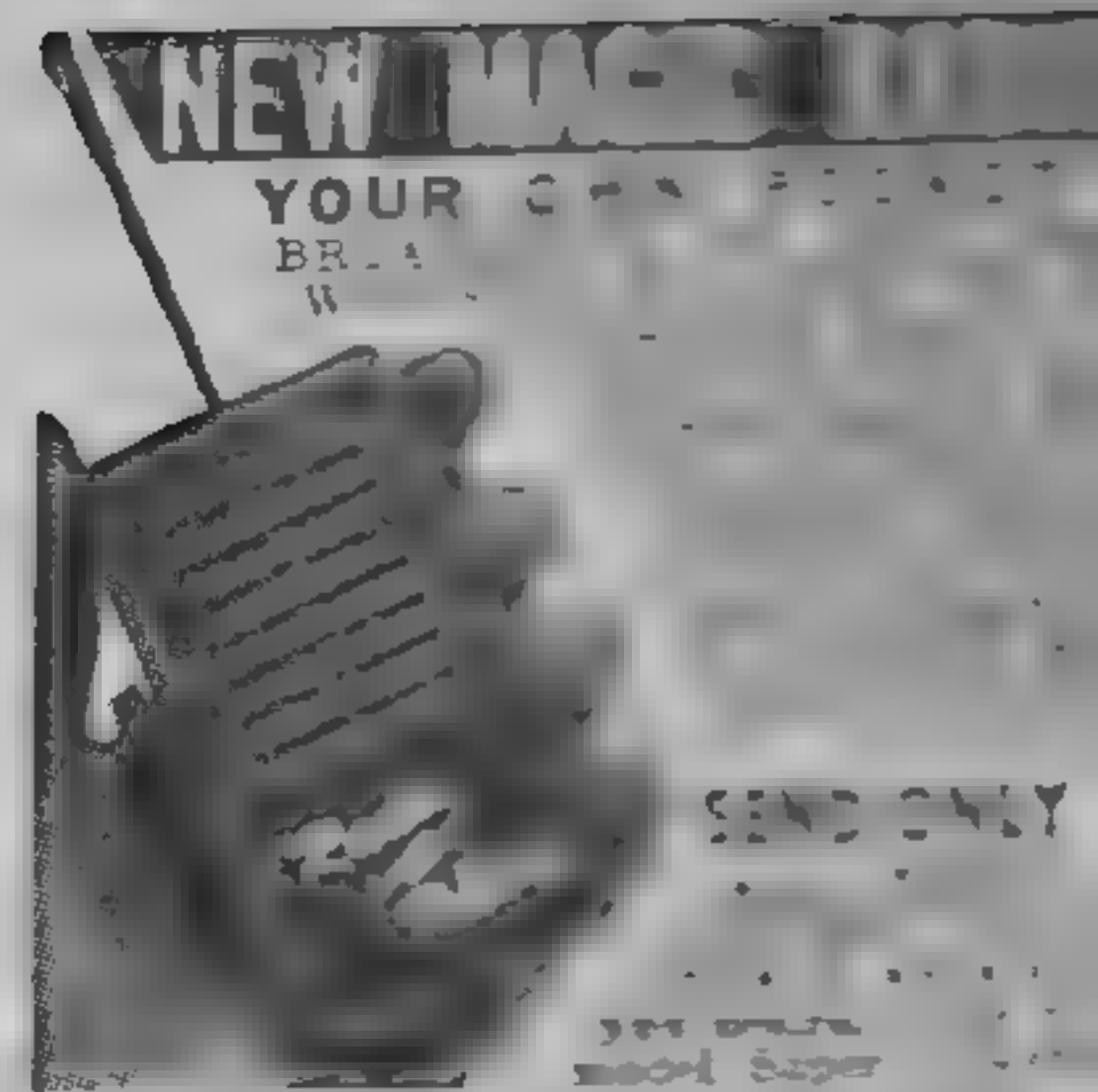
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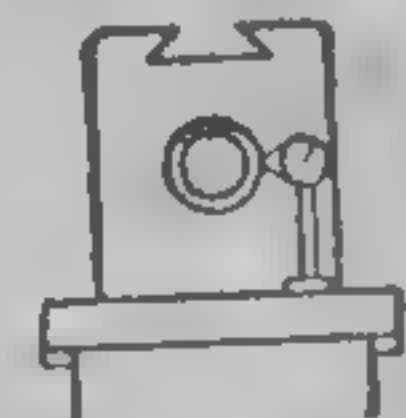
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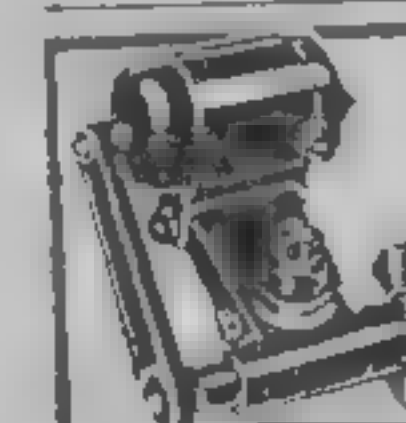
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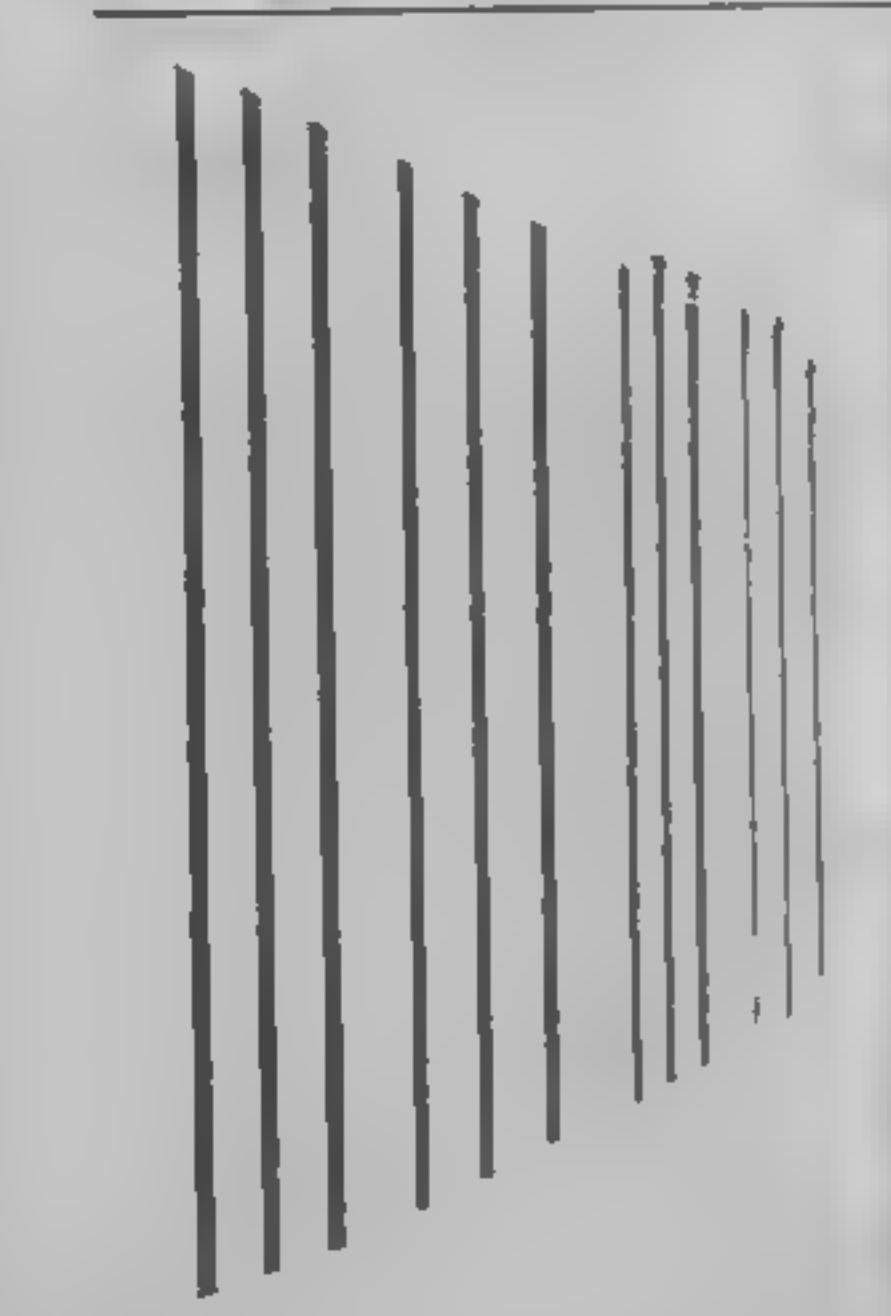
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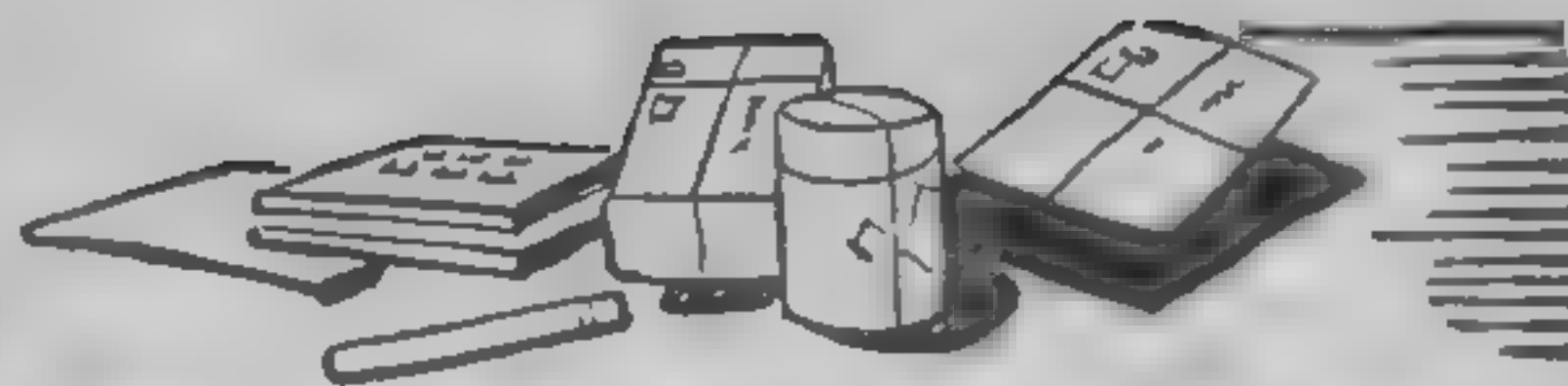
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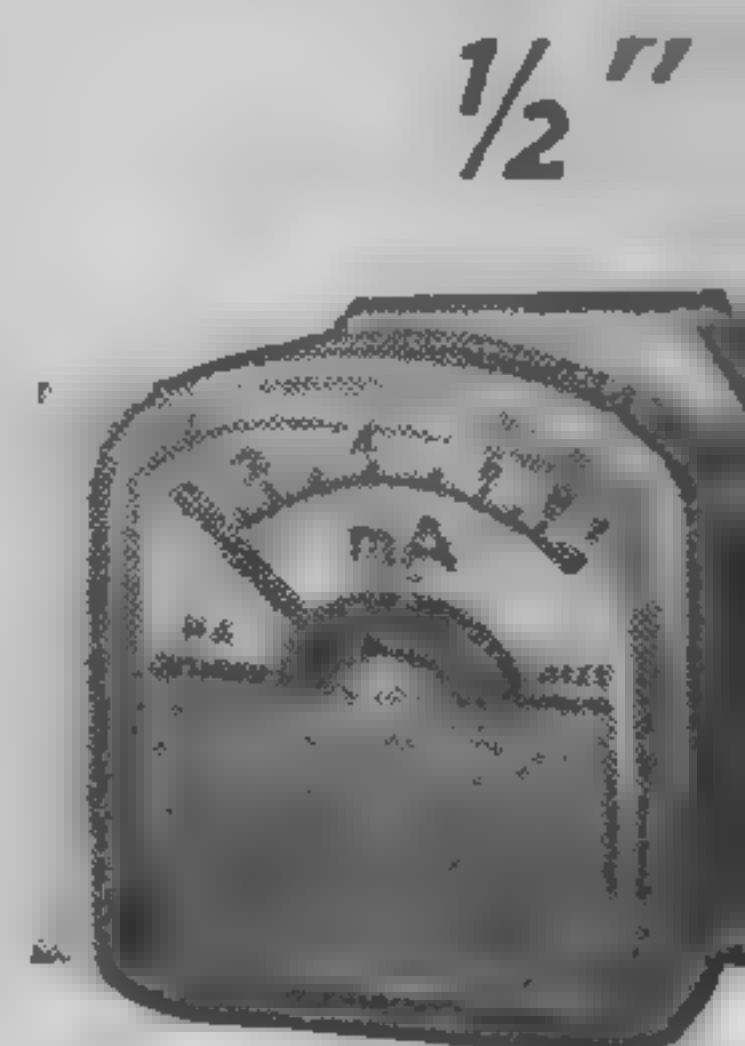
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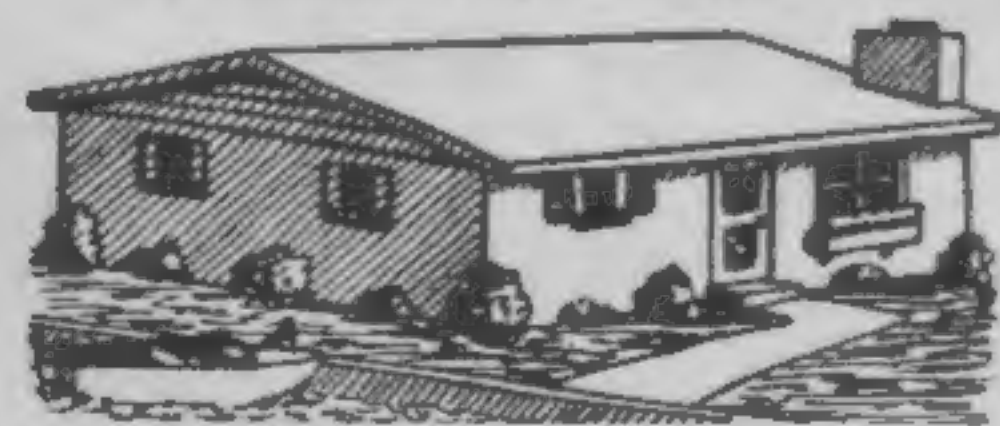
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Build your own 22'x26' cottage complete for \$1,000. Slab floor, beamed ceiling. Contains Liv. Rm., kitchen, two bedrooms, bath and fireplace. Blueprints, instructions and material list \$2.00 ppd. Money back guarantee. Other plans—\$1150 Garage Apt., \$1900 Duplex, \$2500 Ranch Home, \$3500 Cape Cod, \$3800 three bedroom, two bath, family room Ranch Home.

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AND PASTE
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CARD

"I SAW MYSELF 10 YEARS FROM NOW!"



It happened one payday...

Fred worked on the line next to me. Nice guy. Married. Two children. Been on the same job 10 years.

As we walked away from the pay window together he said, "Funny. Each week I get to feel like I'm letting my family down. You know. Not getting ahead so I can give them the things they need."

His words hit me all of a sudden. I could see myself saying the same thing—10 years from now!

Not only that. I could see the same job. Same thin paycheck. Same worries.

I thought about Fred all day. Then that night

I saw an ad for I.C.S. It told about the job opportunities that open up with I.C.S. training. How people had found new careers and job success.

I mailed the coupon and that was the start. In just a few months my boss discovered I was an I.C.S. student. He was so pleased he decided to move me off the line. A year and two raises later I was made an assistant supervisor.

What about Fred? He's still working on the line. Still hoping for the future.

I told him about I.C.S. But so far he hasn't done anything. I guess some people never will.

How about you?

For Real Job Security—Get an I. C. S. Diploma!

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- Without cost or obligation, send me "HOW to SUCCEED" and the opportunity booklet about the field BEFORE which I have marked X (plus sample lesson):
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CHEMICAL
<input type="checkbox"/> Analytical Chemistry
<input type="checkbox"/> Chemical Engineering
<input type="checkbox"/> Chem. Lab. Technician
<input type="checkbox"/> Elements of Nuclear Energy
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<input type="checkbox"/> Natural Gas Prod. and Trans.
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<input type="checkbox"/> Civil Engineering
<input type="checkbox"/> Construction Engineering
<input type="checkbox"/> Highway Engineering
<input type="checkbox"/> Professional Engineer (Civil)
<input type="checkbox"/> Reading Struc. Blueprints
<input type="checkbox"/> Sanitary Engineer
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DRAFTING
<input type="checkbox"/> Aircraft Drafting
<input type="checkbox"/> Architectural Drafting
<input type="checkbox"/> Drafting & Machine Design
<input type="checkbox"/> Electrical Drafting
<input type="checkbox"/> Mechanical Drafting
<input type="checkbox"/> Sheet Metal Drafting
<input type="checkbox"/> Structural Drafting
ELECTRICAL
<input type="checkbox"/> Electrical Engineering
<input type="checkbox"/> Elec. Engr. Technician
<input type="checkbox"/> Elec. Light and Power
<input type="checkbox"/> Practical Electrician
<input type="checkbox"/> Practical Lineman
<input type="checkbox"/> Professional Engineer (Elec)
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<input type="checkbox"/> High School Diploma | <input type="checkbox"/> Good English
<input type="checkbox"/> High School Mathematics
<input type="checkbox"/> High School Science
<input type="checkbox"/> Short Story Writing
LEADERSHIP
<input type="checkbox"/> Industrial Foremanship
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<input type="checkbox"/> Personnel-Labor Relations
<input type="checkbox"/> Supervision
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Alfred W. Walter tried
1958. In Less than 2
VX-6, made more money
Without any knowledge
Electrical Demonstrat

Prove

"I tried VX-6 first in my
bile. Results were so an
ordered an \$18.00 tra
started selling friends, th
it was just as easy to sell
such as farmers, taxis, and
local governments. Best w

65 Million Reasons

There are over 67 million
the road. Over 2 million
use VX-6, leaving you
and responsive machine
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is needed for the life of

FREE! Scientific



SEE
"Yes, we want to
be a successful
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right before you
your letter. We
charge. We will
it as directed.
TEST the water
on light. We will
DO NOT TEST

THEY'RE



Carl Roberts
Calif.



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ALFRED W. WALTER, Florida

YOU TOO CAN MAKE \$1,000 EVERY MONTH!

HOW THIS COUPON LED TO \$6,345 BUSINESS IN LESS THAN 2 MONTHS!

Read this Secret of Selling, Then CASH IN FOR YOURSELF

Alfred W. Walter tried our \$18.00 sample offer during the summer of 1959. In *Less than 2 months*, he reordered over 500 dozen units of VX-6, made more money in a month than many men make in a year. Without any knowledge or experience in cars, his FREE palm-sized Electrical Demonstration Unit closed sales in 30 seconds flat.

Proved In His Own Oldsmobile

"I tried VX-6 first in my own Oldsmobile. Results were so amazing that I ordered an \$18.00 trial shipment, started selling friends, then found that it was just as easy to sell volume users such as farmers, taxis, used car dealers, local governments, boat owners, service

stations, department stores and industrial users.

"My palm-sized Electronic Demonstrator does my selling for me. The most fantastic, convincing selling device I have ever seen—easily worth \$20,000 a year to me in sales and profits."

65 Million Reasons Why You Should Answer This Ad

There are over 67 million cars on the road. Over 2 million already use VX-6, leaving you a fantastic and responsive market. One application at only \$2.98 is all that is needed for the life of the car.

Your story is as simple as that, and these facts are something that can't be resisted by any motorist with a battery in his car and a brain in his head.

FREE! Scientific NEW Electronic DEMONSTRATOR!



Engineered exclusively by National Dynamics, this mighty midget sales-maker nestles in the palm of your hand... works a small miracle before the prospect's eyes! Put the prongs in *any* glass of water, then add VX-6 (instantly creating electronic conductivity through the water.) **THE BULB LIGHTS UP**, yet water remains safe enough to drink!

IN JUST 30 SECONDS

you have presented **PROOF POSITIVE** that VX-6 WORKS... yet it **WILL NOT HARM** battery! You get this palm-size wonder-worker **FREE** with your first order!

When The Bulb Lights, The Sale Is Made!

SEEING IS BELIEVING

"Yes, one actual demonstration beats a mouth-ful of words." You can **PROVE** how VX-6 works, right before your very eyes. If your battery won't even hold a charge, put one unit of VX-6 into it as directed, **THEN TORTURE TEST** the battery like this. Turn on lights, step on starter, **BUT DO NOT TURN ON IGNITION.**

Run the battery down completely until it is so weak the lights barely glow. Now turn off the light switch. Wait 3 minutes. Switch on the ignition and turn (or step) on the starter. The battery with VX-6 in it will start the car with a surge of power **IT REGAINED IN THOSE FEW MINUTES.**

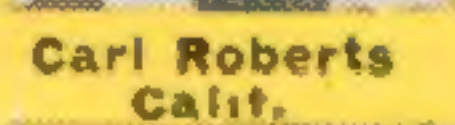
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Every Month Part Time

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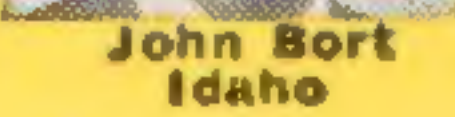
S. Lester
Mass. ... \$53,139.28
In 1957, 1958, 1959

B. Ray
Virginia ... \$23,894.55
In 1958, 1959

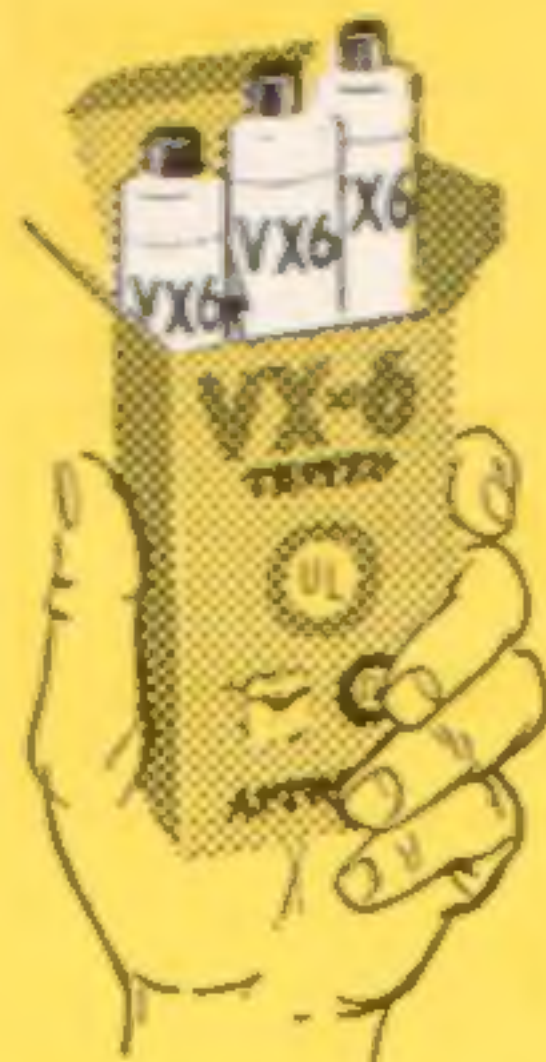
S. J. Lane
New York ... \$15,890.30
In One Year Only



Peter Janzen
Illinois ... \$2,955.84
6 Mos. Part Time Selling This Year



C. Strombuck
Ohio ... \$1,659.52
First 3 Months Part Time



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FREE SALES KIT



NO EXPERIENCE NEEDED

Every car of any kind, any year, model or condition needs VX-6 protection. One application is all that is needed for the life of the car, and immediately old batteries spring back to life. Even new batteries are kept free of sulfation so that they start at their peak of performance always. Sell friends, neighbors, delivery trucks, fleet cabs, company cars and local governments. A single call can mean multiple sales that pay off in hundreds of dollars.

Sales Guaranteed or Money Refunded

Yes, this is the offer that National Dynamics makes you! Send coupon below for the free, complete VX-6 Sales Kit, big earnings plan, illustrated literature—everything you need to get started at once making good money in your area **PLUS INFORMATION ON HOW TO GET YOUR FREE ELECTRONIC DEMONSTRATOR.**

New Rubber Stamp Business Pays Beginners ^{UP} ~~TO~~ \$9.20 an hr.

START AT HOME IN SPARE TIME WITH THIS LITTLE TABLE TOP MACHINE

The multi-million dollar Rubber Stamp Business—once controlled by a few big companies—is now being taken over by small home operators—one in each community throughout the U. S. Men and women who have this inexpensive machine can turn out huge quantities of Rubber Stamps with special wording that buyers once were forced to order from big cities. Material costing only 27¢ makes a stamp that sells for \$1.80. The machine that does the work is simple and easy to operate and it turns out as many as six Rubber Stamps at a time each with different wording such as names, addresses, notices, stock numbers, prices and other "copy" needed by factories, offices and individuals. Working full capacity, it can earn as much as \$9.20 an hour for the operator! Now you can get into the big-pay business yourself with your own home as headquarters. You don't need any experience. We supply everything, including complete instructions and eight ways to get business coming in fast. Start making up to \$9.20 an hour from the very beginning. Cash in on the profitable Rubber Stamp business in your community right away.



**TAKES UP ONLY 2
SQUARE FEET OF
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ONLY 11 POUNDS!**

NEW WARNER SUCCESS PLAN

Tells How to Build—Step by Step—to Big Profits and Personal Independence. Read This Plan for Two Weeks Entirely At My Risk!

In this amazing Plan you will find exact and detailed instructions for starting a Home Business in spare time—without giving up your present job and without risking the loss of a single pay check. The Warner Plan shows you—with pictures, photographs and drawings—just how to make Rubber Stamps just as good as those turned out by the big companies. It shows how to get orders *without canvassing or house-to-house selling*. It shows you how to expand, how to get others to work for you and how to be **SURE** of at least twice the money you make on your present job for a life of personal independence.

But don't make any decision now. Read the Plan first—entirely at my risk. Then—after you have made a careful investigation—after you have talked things over with your family—only then do you decide what you want to do.

The thing to do now is to get full details which I'll send you **FREE** no salesman will call to urge you to buy anything. Mail coupon now—or just send a postcard—and I'll see that complete information goes out to you by return mail—postpaid.

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HOW TO make "Special" Rubber Stamps.

HOW TO get the right price for the Rubber stamps you make.

HOW TO figure costs so you will be sure of a substantial profit on all the work you turn out.

HOW TO set up your workshop.

HOW TO get the most out of Warner's "Eight Tested Sources for Getting Business."

HOW TO get started on a cash outlay so small that you can get back your entire investment inside of two weeks.

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